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SOUTHWESTERN

RANGE & SHEEP BREEDING LABORATORY

FORT WINGATE, NEW MEXICO

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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
COOPERATING WITH THE
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
AND THE
NEW MEXICO AGRICULTURAL EXPERIMENT STATION

1953-54 **18** REPORT
FIRST BIENNIAL

THIS REPORT OF RESEARCH PROJECTS NOT YET COMPLETED IS INTENDED FOR THE USE OF ADMINISTRATIVE LEADERS AND WORKERS IN THIS OR RELATED FIELDS OF RESEARCH, AND NOT FOR GENERAL DISTRIBUTION.

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ROSTER OF PERSONNEL

<u>Name</u>	<u>Title</u>	<u>Date entered on duty</u>	<u>Duties</u>
Stanley L. Smith	Animal Husbandman	Jul. 23, 1952	Director
George M. Sidwell ¹	Animal Husbandman	Dec. 1, 1946	Genetics
Gordon L. Jessup, Jr.	Animal Husbandman	Mar. 17, 1952	Sheep Invest- igations
Vern B. Swanson ²	Animal Husbandman	Apr. 10, 1951	Sheep Manage- ment
Alison S. Dodge	Clerk-Stenographer	June 3, 1951	Clerical
Glenn C. Perkins	Farm Foreman	Sept. 24, 1954	Operations
Jimmie Gleason	Maintenance Man	Apr. 1, 1942	Maintenance
Marion Chadacloi ³	Laboratory Aid	Jan. 12, 1944	Miscellaneous
Fred Deschene	Labor Leader	Oct. 2, 1947	Camp Tender
Alfred Dempsey ⁴	Maintenance Man	Dec. 23, 1947	Miscellaneous
Homer Dick	Laborer	Apr. 7, 1953	Miscellaneous

1. Dr. George M. Sidwell moved to the New Mexico Agricultural Experiment Station, State College, New Mexico, March 1, 1954 where he is engaged in sheep breeding research of interest to both the New Mexico Station and the Sheep Breeding Laboratory. He also serves to coordinate the activities in sheep breeding research of the two institutions.

2. Entered on Leave Without Pay September 12, 1954

3. Resigned February 27, 1953

4. Transferred to Bureau of Indian Affairs, September 30, 1954

OBJECTIVE

The main objective of this laboratory is the development of types of sheep which are adapted to the semi-arid range conditions of the southwest, and to the economic requirements of Navajo Indians and other sheepmen of this area. In the pursuit of this objective, basic breeding methods are employed, utility values of the wool are studied and the selection of breeding animals is based upon production as measured under range environment. Emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

OUTLINE OF RESEARCH PROGRAM

In order to achieve the above objective in the development of breeds and strains of sheep suitable to the southwestern ranges and to the economic requirements of the sheepmen, there are four active research projects under way. These projects are carried out under U. S. Department of Agriculture Work Projects ARS-b-2-1, Sheep Breeding Investigations and ARS-b-2-6, Investigations of Wool and Other Animal Fibers. The four projects at Fort Wingate are as follows:

1. Improvement of Navajo sheep by linebreeding and selection in the Navajo strain.
2. Improvement of Navajo sheep by crossbreeding and selection for the production of wool suitable for both hand and commercial methods of manufacture.
3. Improvement of Navajo sheep by crossbreeding and selection for range production of wool and lambs.
4. Development of an efficient method of selecting animals used in the program of the Southwestern Range and Sheep Breeding Laboratory.

(NOTE: When reference is made to the above projects in the following sections of this report, only the number preceding the project title will be used.)

PUBLICATIONS

The following papers have been published since the establishment of the Southwestern Range and Sheep Breeding Laboratory:

1. The Navajo Sheep Industry and Needs for Its Improvement:
J. M. Cooper, the Sheep Breeder, May 1939.
2. The Sheep Industry of Indians in the Southwest:
J. M. Cooper and Dewey Dismuke, Indians at Work, August 1939.
3. Breeding for Adaptability to Local Conditions, with Special Reference to Sheep on the Navajo Indian Reservation:
J. M. Cooper, American Society of Animal Production, 1939.
4. Improvement of the Navajo Sheep:
Cecil T. Blunn, Journal of Heredity, March 1940.
5. Breeding for Quality Wool:
James O. Grandstaff, The National Wool Grower, July 1940.
6. A Rapid Method for Projecting and Measuring Cross Sections of Wool Fibers: James O. Grandstaff and Walter L. Hodde, Circular No. 590, U. S. Department of Agriculture, December 1940.
7. Evaluating Fleece Characteristics of Navajo Sheep from a Breeding Standpoint:
James O. Grandstaff, Rayon Textile Monthly, October-November 1941.
8. Wool Characteristics in Relation to Navajo Weaving:
James O. Grandstaff, Technical Bulletin No. 790, U. S. Department of Agriculture, January 1942.
9. Characteristics and Production of Old-Type Navajo Sheep:
Cecil T. Blunn, Journal of Heredity, May 1943.
10. The Influence of Seasonal Differences on the Growth of Navajo Lambs:
Cecil T. Blunn, Journal of Animal Science, February 1944.
11. A preliminary Report on the Post-Natal Development of the Fiber Characteristics of the Fleeces of Navajo Sheep:
James O. Grandstaff and Cecil T. Blunn, Journal of Animal Science, May 1944.
12. Comparison of the Yields of Side Samples from Weanling and Yearling Sheep:
Cecil T. Blunn and James O. Grandstaff, Journal of Animal Science, May 1945.

13. Yearly Differences in Growth of Navajo and Crossbred Ewe Lambs:
Cecil T. Blunn, Journal of Animal Science, August 1945.
14. Evaluating Fleece Quality of Navajo Sheep from Small Samples:
James O. Grandstaff and Cecil T. Blunn, Journal of Agricultural Research, September 1945.
15. Improvement of Wool for Navajo Hand Weaving:
James O. Grandstaff and Cecil T. Blunn, Indians at Work, March 1945.
16. Relation of Kemp and Other Medullated Fibers to Age in the Fleeces of Navajo and Crossbred Lambs:
James O. Grandstaff and Harold W. Wolf, Journal of Animal Science, May 1947.
17. Comparison of Corriedale x Navajo and Romney x Navajo Crosses:
James O. Grandstaff, Journal of Animal Science, November 1948.
18. Size of Lambs at Weaning as a Permanent Characteristic of Navajo Ewes:
George M. Sidwell and James O. Grandstaff, Journal of Animal Science, August 1949.
19. Adaptation of Livestock to New Environments: James O. Grandstaff, for publication in Proc. United Nations Scientific Conference on Conservation and Utilization of Resources, Lake Success, New York, 1949.
20. Fertility and Reproduction in Sheep in Relation to Breeding and Environment:
James O. Grandstaff, presented at International Symposium on High Altitude Biology held at Lima, Peru, South America, November 23-30, 1949.
21. Genetic and Environmental Factors affecting Staple Length in Navajo and Navajo Crossbred Weanling Lambs:
George M. Sidwell, James O. Grandstaff and Donald A. Price, Journal of Animal Science, February 1951.
22. Lamb Production of Navajo Ewes Bred to Columbia and Romney Rams, and Navajo Crossbred Ewes Bred to Lincoln and Cotswold Rams:
Donald A. Price, James O. Grandstaff and George M. Sidwell, Journal of Animal Science, February 1951.
23. Genetic and Environmental Factors Affecting Type and Condition in Navajo and Navajo Crossbred Weanling Lambs:
George M. Sidwell, Donald A. Price and James O. Grandstaff, Journal of Animal Science, May 1951.
24. Effects of Some Genetic and Environmental Factors on Yearling Traits of Navajo and Navajo Crossbred Ewes:
Donald A. Price, George M. Sidwell and James O. Grandstaff, Journal of Animal Science, November 1953.

1. The first part of the paper discusses the importance of maintaining accurate records of all transactions. It is essential for the business to have a clear and concise record of all income and expenses. This will help in the preparation of the tax return and in the event of an audit.

2. The second part of the paper discusses the importance of keeping the books up to date. It is important to record all transactions as they occur, rather than waiting until the end of the year. This will help in the preparation of the tax return and in the event of an audit.

3. The third part of the paper discusses the importance of keeping the books separate from the personal accounts. It is important to have a clear distinction between the business and personal accounts. This will help in the preparation of the tax return and in the event of an audit.

4. The fourth part of the paper discusses the importance of keeping the books in a safe place. It is important to protect the books from fire, theft, and other disasters. This will help in the preparation of the tax return and in the event of an audit.

5. The fifth part of the paper discusses the importance of keeping the books in a clear and concise manner. It is important to use a system that is easy to understand and that is consistent with the accounting principles. This will help in the preparation of the tax return and in the event of an audit.

6. The sixth part of the paper discusses the importance of keeping the books in a timely manner. It is important to record all transactions as they occur, rather than waiting until the end of the year. This will help in the preparation of the tax return and in the event of an audit.

7. The seventh part of the paper discusses the importance of keeping the books in a complete manner. It is important to record all transactions, including the smallest ones. This will help in the preparation of the tax return and in the event of an audit.

8. The eighth part of the paper discusses the importance of keeping the books in a correct manner. It is important to use the correct accounting principles and to record all transactions accurately. This will help in the preparation of the tax return and in the event of an audit.

9. The ninth part of the paper discusses the importance of keeping the books in a clear and concise manner. It is important to use a system that is easy to understand and that is consistent with the accounting principles. This will help in the preparation of the tax return and in the event of an audit.

10. The tenth part of the paper discusses the importance of keeping the books in a timely manner. It is important to record all transactions as they occur, rather than waiting until the end of the year. This will help in the preparation of the tax return and in the event of an audit.

SUMMARY OF PRECIPITATION

	Fort Wingate				El Morro		
	Average 1864-1911	Average 1938-1952	1953	1954	Normal	1953	1954
January	.96	.98	.20	.64	.93	.63	.43
February	1.42	.61	.67	.41	.84	.30	.27
March	1.02	.87	.65	3.85	1.18	1.40	1.61
April	.98	.66	.62	.41	.60	1.01	Tr.
May	.58	.58	.14	1.55	.41	.30	1.32
June	.69	.54	.71	.23	.53	.15	.60
July	2.34	1.61	2.42	4.17	1.80	2.51	2.28
August	2.31	2.21	.73	.96	2.76	1.52	2.82
September	1.37	1.27	.00	1.74	1.46	.00	3.05
October	1.05	1.05	1.16	.69	1.01	.53	.65
November	.76	.71	.78	.12	.52	.56	.11
December	.97	1.02	1.02	.49	1.03	.95	.45
ANNUAL	14.45	12.11	9.10	15.26	13.07	9.86	13.59

The above table summarizes the precipitation at Fort Wingate and El Morro, New Mexico. The El Morro data is presented because the ewes and lambs are grazed on the El Morro range for a large part of the year and because there are sometimes appreciable differences in the amounts of precipitation between the two locations. Data at Fort Wingate from 1938 to the present have been compiled from Station records: all other data have been secured from U. S. Weather Bureau reports.

BIOGRAPHICAL SKETCH

Early Life			Education				Career	
Date	Place	Event	Date	Place	Institution	Degree	Date	Position
1870	St. Louis	Born	1888	St. Louis	St. Louis University	B.A.	1890	Teacher
1892	St. Louis	Married	1895	St. Louis	St. Louis University	M.A.	1898	Principal
1905	St. Louis	Graduated	1908	St. Louis	St. Louis University	Ph.D.	1910	Professor
1912	St. Louis	Graduated	1915	St. Louis	St. Louis University	Ph.D.	1918	Professor
1920	St. Louis	Graduated	1923	St. Louis	St. Louis University	Ph.D.	1925	Professor
1928	St. Louis	Graduated	1931	St. Louis	St. Louis University	Ph.D.	1933	Professor
1935	St. Louis	Graduated	1938	St. Louis	St. Louis University	Ph.D.	1940	Professor
1942	St. Louis	Graduated	1945	St. Louis	St. Louis University	Ph.D.	1947	Professor
1950	St. Louis	Graduated	1953	St. Louis	St. Louis University	Ph.D.	1955	Professor
1958	St. Louis	Graduated	1961	St. Louis	St. Louis University	Ph.D.	1963	Professor
1965	St. Louis	Graduated	1968	St. Louis	St. Louis University	Ph.D.	1970	Professor
1972	St. Louis	Graduated	1975	St. Louis	St. Louis University	Ph.D.	1977	Professor
1980	St. Louis	Graduated	1983	St. Louis	St. Louis University	Ph.D.	1985	Professor
1988	St. Louis	Graduated	1991	St. Louis	St. Louis University	Ph.D.	1993	Professor
1995	St. Louis	Graduated	1998	St. Louis	St. Louis University	Ph.D.	2000	Professor
2002	St. Louis	Graduated	2005	St. Louis	St. Louis University	Ph.D.	2007	Professor
2010	St. Louis	Graduated	2013	St. Louis	St. Louis University	Ph.D.	2015	Professor
2018	St. Louis	Graduated	2021	St. Louis	St. Louis University	Ph.D.	2023	Professor

I, the undersigned, certify that the foregoing is a true and correct statement of the facts of the life of the person named above, as far as the same are known to me.

Witness my hand and seal this _____ day of _____, 19____.

 Secretary of the Board of Education

WEATHER CONDITIONS

1953

On a statewide basis, 1953 was the fifth driest year since 1892, exceeding by only 0.33 inch the driest year on record. At Fort Wingate, 1953 was the second driest year since 1938. Precipitation for the year totaled 9.10 inches. This amount is 63.0 percent of the 47-year average (1864-1911), or 75.1 percent of the 1938-1952 average. At El Morro, the 9.86 inches of precipitation amounted to 75.4 percent of normal. During the growing season (May through September) Fort Wingate and El Morro received 6.21 and 6.96 inches of precipitation, respectively. This was approximately 64.4 percent of the more recent normal for both localities.

September and January were the two driest months of the year, and were also the driest January and September on record. July was the only month of the year that received more than the normal amount of precipitation.

1954

Despite above average amounts of precipitation at both Fort Wingate and El Morro for the year, 1954 can be characterized as a warm and relatively dry year. Temperatures for the year were above normal for most of the year, with only March and August being below average, but by less than one half degree. High winds prevailed during the late winter and spring months, and several severe storms occurred in May and July.

The period from March through September presented months that were alternately above and below average in precipitation. The remainder of the year was considerably below average. Many of the rain storms left relatively large amounts of precipitation, but were preceded and followed by hot, dry, windy weather which caused much of the moisture to be lost by rapid run off and evaporation.

In July, two storms within less than a week left 1.07 and 1.06 inches of rain, respectively. Most of this water was lost through runoff, but many of the stock tanks were filled.

SUMMARY OF OPERATIONS

1953

During the early months of the year, additional breeding ewes of "average" reservation quality were secured to complete the flock of 400 needed to establish a new sheep improvement experiment. This experiment was part of the plan-of-work agreed upon by the members of the wool conference held at the Laboratory on September 16 - 17, 1952.

Sampling of fleeces and scoring various physical characteristics of all newly acquired "average" reservation ewes and the yearling ewes and yearling and mature rams of the Laboratory flocks was accomplished April 13 to 15, inclusive. Shearing of all sheep took place the last week of April. Lambing began May 1, 1953 and lasted until June 15. Mr. T. D. Watkins arrived from the Agricultural Research Center, Beltsville, Maryland, the first of June to run the small fleece sample determinations for estimating clean fleece weight.

The late winter, spring, and early summer of 1953 were very dry, with below average temperatures. New grass did not begin to grow until after the rains in July. Since the Fort Wingate range had not been used during the two previous years, there was sufficient old forage on the ground to carry the flocks until mid-July when new grass became available. By the middle of June, however, the situation was beginning to look desperate.

In early June, it was learned that the U. S. Public Health Service had turned over to the State of New Mexico their hospital located at Fort Stanton, New Mexico, and that approximately 26,000 acres of grazing land, formerly property of the hospital, had been declared surplus. The Laboratory attempted to obtain a temporary grazing lease on this land as an emergency measure to secure feed for the sheep that were then barely subsisting on ranges heavily hit by the drought. The Fort Stanton property is highly desirable grazing land, however, and a number of divergent interests immediately attempted to obtain the land for their own use. The matter rapidly became a "hot" political issue, and the Laboratory withdrew its request for the lease. Luckily, the rains began early in July and we were able to move the sheep to El Morro range about the middle of the month.

During the latter part of the summer, water became scarce in the surface tanks, and it was anticipated that it would be necessary to truck water to the sheep. However, our camp tender, Mr. Fred Deschene, dug out several seeps, piping the water into troughs, thereby obtaining enough water to supply the sheep.

Weanling data on the lambs were obtained the first week of September, and both the ewes and the lambs were culled the second week of October. Semen testing was completed during the first half of November and the Laboratory developed ewes were returned to Fort Wingate for weighing and branding on December first. The ewes obtained from the Navajo reservation were left on the El Morro range where they were divided at random into four groups of equal numbers and weighed and branded. The ewes and rams were herded separately on the range during the day, and were cut into their respective breeding lots each evening. Breeding, both at Fort Wingate and El Morro, occurred from December 4, 1953 through January 5, 1954.

1954

Upon completion of breeding on January 5, 1954, all sheep at Fort Wingate were returned to El Morro, where they remained until early April when all sheep were brought back to Fort Wingate for scoring and sampling.

Scoring and sampling were accomplished April 14 to 16, inclusive, and shearing occurred from April 20 through 23, inclusive. Lambing began April 26 and ended May 31. As lambing progressed, Navajo and Navajo crossbred ewes with lambs were returned to El Morro range, while the "average" reservation ewes and lambs were moved to the Fort Wingate range. Since the reservation ewes were in poorer condition than the other ewes and were showing markedly less mothering ability, it was felt the long haul to El Morro range would have caused a considerable number of these lambs to have been weaned and thus lost. They were moved to El Morro range and mixed with the rest of the herd in July, when they were better able to withstand the moving.

Bluetongue, a newly recognized disease of sheep in the United States, was first identified in flocks adjacent to the Laboratory flocks in the summer of 1954. All Laboratory sheep were vaccinated as soon as the newly developed vaccine became available, and they will continue to be vaccinated annually until such time as the disease is considered eradicated. No losses due to Bluetongue have occurred in the Laboratory flocks.

In June, 47 yearling Targhee ewes were obtained from private breeders in Idaho and Montana. In November, 10 yearling and 45 mature Targhee ewes and 10 Targhee rams were obtained from the U. S. Sheep Experiment Station, Dubois, Idaho. These sheep were acquired to start a line of purebred Targhee sheep for testing purposes.

Weaning of the lambs and collection of weanling data was completed the first week in September, and the ewes and lambs were culled October 11 to 15, inclusive. Semen testing occupied the first two weeks of November, and breeding, which followed the same pattern as in 1953, lasted from December 6, 1954 to January 7, 1955.

OUTLINE OF BREEDING PROGRAM

Type of Breeding and Group Number	Breeding of Rams	Breeding of Ewes	Number of Ewes Breeding Seasons	
			1952-3	1953-4
Navajo 1	N	N	105	124
Coarsewool				
8	$C_2 \times (C_1 \times N)(R_1 \times N)$ $(R_1 \times N)(C_1 \times N)$	K x N	60	46
9	K x N	$C_2 \times (C_1 \times N)(R_1 \times N)$ $(R_1 \times N)(C_1 \times N)$	38	29
10	$R_1 \times N$	$L \times (C_1 \times N)(R_1 \times N)$ $(R_1 \times N)(C_1 \times N)$	68	55
11	$L \times (C_1 \times N)(R_1 \times N)$ $(R_1 \times N)(C_1 \times N)$	$R_1 \times N$	30	28
Finewool				
16	$(K \times N) \times [C_2 \times (C_1 \times N)(R_1 \times N)]$ $(R_1 \times N)(C_1 \times N)$	$[L \times (C_1 \times N)(R_1 \times N)] \times (R \times N)$	102	185
12	T	$(C_1 \times N)(R_1 \times N)$ $(R_1 \times N)(C_1 \times N)$	58	40
13*	$T \times (C_1 \times N)(R_1 \times N)$ $(R_1 \times N)(C_1 \times N)$	$T \times (C_1 \times N)(R_1 \times N)$ $(R_1 \times N)(C_1 \times N)$	45	79

$$1 + \sqrt{1 + 4 \times 10^5 \times 10^5} = 1$$

$$10^5 \times 10^5 = 10$$

12

13

$$10^5 \times 10^5 = 10$$

14

15

$$1 + \sqrt{1 + 4 \times 10^5 \times 10^5} = 1$$

$$10^5 \times 10^5 = 10 \times 10^5$$

16

17

$$1 + \sqrt{1 + 4 \times 10^5 \times 10^5} = 1$$

$$10^5 \times 10^5 = 10$$

18

19

$$1 + \sqrt{1 + 4 \times 10^5 \times 10^5} = 1$$

20

21

$$1 + \sqrt{1 + 4 \times 10^5 \times 10^5} = 1$$

22

23

$$1 + \sqrt{1 + 4 \times 10^5 \times 10^5} = 1$$

$$10^5 \times 10^5 = 10$$

24

25

1

2

3

4

5

OUTLINE OF BREEDING PROGRAM, CONTINUED

Type of Breeding and Group Number	Breeding of Rams	Breeding of Ewes	Number of Ewes Breeding Seasons 1952-3 1953-4
Reservation			
20	Res	Res	- 89
21	R ₂	Res	- 90
22	T	Res	- 87
23	W	Res	- 89
Targhee			
25	T	T	- -
Totals			506 941

* Group 13 contains a few ewes and rams that have inheritance from Rambouillet, Debouillet, and Merino sires that were used in 1948, 1949 and 1950. See summary of breeding program (next page) and Annual Reports 1949 - 1951, inclusive.

Code of Symbols for Breeds

C ₁	Corriedale	R ₁	Romney
C ₂	Cotswold	R ₂	Rambouillet
K	Columbia	Res	Reservation
L	Lincoln	T	Targhee
N	Navajo	W	Weaving Wool (Progeny from Group 16 matings)

SUMMARY OF BREEDING PROGRAM

1952 - 1953 Season

The breeding flock for the 1952-1953 season was reduced to 506 ewes in accordance with the plan of work developed at the wool conference held at the Laboratory in September of 1952. (See Sixteenth Annual Report, December 31, 1952). This plan of work called for the breeding of approximately 100 Navajo ewes, 300 Coarsewool ewes and 100 Finewool (Targhee crossbred) ewes. The remaining sound ewes were traded to individual Navajos for average Navajo Reservation type ewes during the fall and winter of 1952-1953. Since many of the Reservation ewes acquired through trading were not obtained until after the breeding season, and since many were ewe lambs not of breeding age, the Reservation ewes were not bred until the 1953-1954 season.

In February, 1953, it was discovered that 11 ewes in group 1, one ewe in group 9, and 3 ewes each in groups 11, 16 and 13 had been accidentally bred prior to the regular breeding season. Consequently, the number of ewes listed below for each of these groups is the number originally assigned to the group minus the number of ewes which were later found to have been bred prematurely.

The various breeding groups were associated with the research line projects as follows:

<u>Breeding Groups</u>	<u>No. of Matings</u>	<u>Research Project No.</u>
1	94	1
8, 9, 10, 11, 16	291	2
12, 13	100	3

The number of Navajo ewes was reduced in accordance with the new plan of work.

Groups 6 and 7, which were discontinued in 1950, involved the matings of Lincoln and Cotswold rams, respectively, to ewes having an inheritance of 1/2 Navajo, 1/4 Romney and 1/4 Corriedale.

In group 8, F₁ Columbia x Navajo ewes were mated to Cotswold cross rams originating from group 7. The matings in group 9 are the reciprocal of those in group 8.

In group 10, Lincoln cross ewes originating from group 6 were mated to F₁ Romney x Navajo rams. The matings in group 11 are the reciprocal of those in group 10.

Summary of Breeding Program, continued.

The ewes and rams in groups 16 and 17 were the progeny of matings in groups 8 and 9, and 10 and 11, respectively. Group 17 was discontinued in 1952 due to small numbers and the change in the breeding plans. Because of the similarity in breeding, the remaining ewes of group 17 were combined with those in group 16. In the future, the progeny from groups 8, 9, 10 and 11 will go into group 16.

Group 12 matings consisted of Targhee rams mated to crossbred ewes carrying an inheritance of 1/2 Navajo, 1/4 Romney, and 1/4 Corriedale.

Group 13 is comprised chiefly of matings between progeny from group 12, but it also contains a few ewes and rams that have inheritance from Rambouillet, Debouillet and Merino sires that were used in 1948, 1949, and 1950. During the period 1948 - 1952, breeding groups 14, 15, T-14, and T-15 were initiated and discontinued. Only a few progeny from each of these groups were saved or survived to breeding age. Due to small numbers, similarity of breeding and association with the same project, these few progeny from each of the breeding groups 14, 15, T-14, and T-15 were combined with group 13. The matings in these four groups were as follows:

- (a) Groups 13 and 14 for the years 1948 and 1949 consisted of crossbred ewes having an inheritance of 1/2 Navajo, 1/4 Romney and 1/4 Corriedale mated to Merino and Debouillet rams, respectively.
- (b) Group 15 for 1949 and 1950 consisted of Rambouillet rams mated to Navajo ewes.
- (c) Group 13 in 1950 consisted of F₁ Rambouillet x Navajo rams mated to Targhee, Debouillet, and Merino crossbred ewes.
- (d) Groups T-14 and T-15 in 1951 were made up of Targhee rams mated to Columbia x Navajo and Romney x Navajo ewes, respectively.

1953 - 1954 Season

The breeding flock for the 1953 - 1954 season was increased to 941 ewes by the addition of the Reservation ewes (groups 20, 21, 22 and 23) and by the natural increases in groups 1, 13 and 16. Groups 8, 9, 10, 11 and 12 continued to decline in numbers as replacement ewes for these groups are no longer being produced.

Summary of Breeding Program, continued.

The various breeding groups were associated with the research line projects as follows:

<u>Breeding Groups</u>	<u>No. of Matings</u>	<u>Research Project No.</u>
1	124	1
8, 9, 10, 11, 16	343	2
23	89	2
12, 13	119	3
20, 21, 22	266	3

Group 1 full blood Navajo ewes were allowed to exceed, by 24, the recommended number of 100 in order to partially offset the losses in numbers in other breeding groups, and to study the production of aged Navajo ewes.

Groups 8, 9, 10 and 11 declined in numbers from 1952 due to necessary culling of aged and unsound ewes. Replacement ewes for these breeding groups are no longer being produced.

Group 16 increased in numbers as progeny from groups 8, 9, 10 and 11, as well as those from 16, went into this breeding group.

Group 12 declined in numbers in 1953 due to necessary culling of aged and unsound ewes. Replacement ewes for this group are no longer being produced.

Group 13 increased in numbers as progeny from group 12, as well as 13, continued to be added to this breeding group.

Groups 20, 21, 22 and 23 are the Reservation ewes obtained in trades with individual Navajos, and mated to Reservation, Tribal Rambouillet, Targhee, and Fort Wingate Coarsewool (weaving wool) rams, respectively. Approximately 420 Reservation ewes and 11 Reservation rams were obtained through trading between November, 1952 and April, 1953. There were considerable death losses during the winter and late spring, however, and by late summer of 1953 only about 360 remained. These were divided at random by age between the four breeding groups by using a table of random numbers (Snedecor, 1948). By breeding time in December a few more had died, as can be seen in the table.

Summary of Breeding Program, concluded.

The four groups are range bred with 10 rams used per 100 ewes. The large number of rams are used in order to secure randomization of breeding.

Group 20 Reservation rams were obtained through trading with individual Navajos, and are of the same type as the ewes. All culling and selection within this group will be made at random so that, in so far as possible, there will be no genetic gain or loss.

Group 21 rams are high grade Rambouillet rams that are rented from the Navajo Tribal Ram Pasture Enterprise. These rams have been purchased by the Navajo Tribe from private breeders, and have met the New Mexico Experiment Station requirements for type, uniformity, fineness of fiber and staple length.

Group 22 rams are purebred Targhees that are purchased from the U. S. Sheep Experiment Station, Dubois, Idaho, or from private breeders.

Group 23 rams are the coarsewool or weaving wool rams that have been developed at the Laboratory. They are the progeny from group 16 matings.

MEASUREMENT OF BODY WEIGHTS, SCORES, FLEECE
CHARACTERISTICS AND SELECTION PROCEDURE

1953

The lambs were born in May at the Laboratory headquarters. As the lambs became old enough, the ewes and lambs were moved out to the nearby Fort Wingate range. They were moved to the El Morro range in July, after the rains began. The lambs were weaned on September 1 and 2 at approximately 120 days of age. At weaning time, each lamb was weighed individually and the weight recorded to the nearest pound. Face covering, type, condition, and outercoat scores were taken by a committee of three men working independently. Color score, degree of horn development, and any abnormality of the jaw were also recorded. Small fleece samples were collected from the middle of the left side and thigh of each lamb at weaning time. From these samples, staple length was measured to the nearest .1 cm. and the percentage of kemp and other medullated fibers was recorded. These samples were then cross-sectioned to determine fiber diameter, also. The staple length measurement represented a constant age of 84 days since a small area was clipped close to the skin when the average age of the lambs was one month and the sample was taken from this area at weaning time.

Culling of the weanling lambs was done in October. The lambs were sorted by sex into their respective breeding pens to facilitate the work of selection. The lambs in each pen were considered individually for all traits evaluated at weaning time. The degree of selection practiced on each pen of lambs depended upon the individual merit of the lambs and the quality and uniformity of the pen of lambs as a group.

The fleeces of yearling ewes and rams and mature breeding rams were sampled a few days previous to shearing, for the evaluation of staple length, grade, percentages of kemp and other medullated fibers, and clean yield. Staple length was measured to the nearest .1 cm. at the side, while average fiber diameter and frequency of kemp and other medullated fibers were measured and recorded for both side and thigh positions. The clean yield was determined from a large sample of wool taken at the side and placed in an airtight can until it was scoured at a later date. At the same time as the sampling, each ewe and ram is individually scored by a committee of three for face covering and degree of outercoat fibers. Color of face and legs, horn development, and jaw formation are also recorded. Body weight and type and condition scores are recorded in June.

At shearing time, the weight of each fleece was recorded to the nearest .05 pound. The grease and clean fleece weights were adjusted to a constant age of 365 days, and the clean fleece weights to standard conditions of 12 percent moisture.

1954

The lambs were born in May at the Laboratory headquarters. As the lambs became old enough, the reservation ewes and lambs (groups 20, 21, 22, and 23) were moved out to the nearby Fort Wingate range. All other ewes and lambs were trucked to the El Morro range. In July, the reservation ewes and lambs were trucked to El Morro and mixed with the rest of the flock. The lambs were weaned August 31 and culled in October. All weaning and culling procedures were the same in 1954 as in 1953.

In addition to the usual data collected a few days before shearing, each yearling ewe and ram and mature ram was individually weighed to the nearest pound. Density of the fleece was measured by use of the Neale Density Meter. All data collected on the yearling sheep were also collected for the first time on the Reservation ewes and rams, in 1954. This data could not be collected in 1953 due to the unknown ages and shearing dates of the Reservation sheep.

RESEARCH PROJECT 1

IMPROVEMENT OF NAVAJO SHEEP BY LINEBREEDING AND SELECTION IN THE NAVAJO STRAIN

The objective of this project is the improvement of the Navajo strain of sheep in wool production and mutton conformation. This strain of sheep have greatest value as a source of inheritance for hardiness and adaptability to semi-arid areas, high fertility and mothering ability. Improvement in the quality and quantity of the fleece as well as improvement in mutton conformation will increase their usefulness for crossbreeding with improved breeds.

Data on the characteristics and production of the Navajo ewes and rams, and the traits of their weanling and yearling progeny are summarized in this section.

The data on weanling lambs has been adjusted to a constant age and for differences due to type of birth and rearing and for age of dam.

CHARACTERISTICS OF NAVAJO BREEDING RAMS

Number of rams used, age of the rams at lambing, and fleece characteristics of the Navajo rams mated to Navajo ewes in the years 1947 through 1954 are summarized in the following table. The data were taken on all rams at yearling age. The rams used have been selected primarily for quality and quantity of wool with some emphasis placed on body weight, type, condition, and color of face and legs. Rams used in 1953 and 1954 averaged less grease fleece and clean fleece weight, shorter staple length, and finer fleeces than those used in prior years. Inasmuch as most of these rams were produced during the drought years of 1950 and 1951, some of this reduction is probably due to environmental factors. There is also some evidence to indicate that part of this reduction is the result of selecting for rams having fleeces that are free, or nearly free, of outercoat fibers.

Since it is not known how severely inbreeding might affect the Navajo sheep, five rams rather than a smaller number are now being used. Until the Navajo strain possesses more of the desirable characteristics both in fleece and body conformation, inbreeding will be held to a minimum as far as it is practical to do so.

CHARACTERISTICS OF NAVAJO BREEDING RAMS

Year	No. of Rams	Age at Lambing (years)	Fleece Weights as Yearlings		Grade*	Yearling Fiber Traits at Side	
			Grease (lbs.)	Clean (lbs.)		Staple Length (cms.)	Medullated Fibers (percent)
1947	3	3.0	6.98	4.93	50s	17.2	1.1
1948	4	3.0	7.56	5.02	48s	18.4	.0
1949	4	4.0	7.15	4.86	48s	17.8	.0
1950	4	2.8	6.93	4.39	48s	13.9	1.8
1951	5	2.8	7.01	4.11	50s	13.1	.0
1952	5	3.4	6.04	3.50	50s	11.9	.5
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1947 - 1952	25	3.2	6.91	4.39	50s	15.1	.5
<hr/>							
1953	5	3.6	5.81	3.67	54s	11.2	.6
1954	5	2.8	5.34	3.20	54s	9.4	.6
<hr/>							
1947 - 1954	35	3.2	6.53	4.12	50s	13.7	.5

* Grade for 1953 and 1954 based on latest ASTM Standards, adopted June 1953.

CHARACTERISTICS OF NAVAJO BREEDING EWES

The following table summarizes the characteristics of the Navajo ewes bred to Navajo rams in the years 1947 through 1954. All traits except the 18 months body weight were measured at yearling age. As Navajo ewes are not presently being used in the crossbreeding program, more stringent culling can be exercised, and more progress from selection can be made. Since most of the traits in the table are greatly affected by many environmental factors, especially that due to years, no very good comparison between years can be made. There is some evidence that the incidence of kemp fibers is being reduced, and also that the trend is toward younger ewes in the breeding flock.

Year	No. of Ewes	Age at Lambing (years)	Body Wt. at 18 Months (lbs.)	Fleece Weights as Yearlings		Grade*	Yearling Fiber Traits at Side		
				Grease (lbs.)	Clean (lbs.)		Staple Length (cms.)	Kemp (per-cent)	Other Med. Fibers (percent)
1947	116	5.7	96.7	4.60	3.18	58s	9.5	0.9	1.7
1948	115	7.4	99.4	5.34	3.68	58s	9.0	0.6	0.6
1949	133	5.0	101.1	5.51	3.64	58s	10.0	0.3	0.8
1950	140	5.1	102.8	5.68	3.69	58s	10.2	0.2	1.2
1951	156	4.9	98.2	5.15	3.08	56s	11.1	0.0	1.5
1952	173	4.8	97.7	5.22	2.91	58s	10.9	0.1	1.6
1953	105	5.3	98.2	5.23	3.11	58s	10.4	0.1	1.7
1954	124	4.9	97.3	5.21	3.19	58s	10.5	0.1	1.1
1947-1954	1062	5.3	99.0	5.25	3.30	58s	10.3	0.3	1.3

* Grade for 1953 and 1954 based on latest ASTM Standards, adopted June, 1953.

LAMB PRODUCTION OF NAVAJO MATINGS

Lamb production of Navajo ewes mated to Navajo rams for the years 1937 through 1954 is summarized in the following table. For the period 1937 through 1951, the percent of ewes lambing was based on the numbers of ewes bred, but beginning in 1952 it is based on the number of ewes bred and still present at lambing. In this way the percentage of ewes lambing is an indication of fertility that is not confounded by post breeding death losses. This percentage is affected by the fertility of both the rams and the ewes. The percent of lambs born of ewes lambing is based on all lambs born, dead or alive, of ewes actually having lambs. This value minus 100 gives the percent of ewes having twins. The percent of lambs weaned of live lambs born is a measure of lamb mortality from birth to weaning. The percent of lambs weaned of ewes bred is a combination of the first three values plus any effect of ewe loss after breeding. The average weaning weight for the years 1937 through 1946 constitutes weights unadjusted for any of the measureable environmental effects, and represents a growth period of about 140 days. Beginning in 1947, the weights are adjusted to a constant age of 120 days and are corrected for type of birth and rearing of the lamb and age of the dam.

There were 105 Navajo ewes originally assigned to breeding pens for 1953, but eleven were later found to have been previously bred to range rams and were therefore not included when computing averages. Of the remaining 94 ewes, 93 survived to lambing time and 87 of these had lambs. Percent of ewes lambing, percent of lambs born of ewes lambing, and percent of lambs weaned of live lambs born were all above average in 1953, and combined, resulted in the highest percentage of lambs weaned of ewes bred since 1946 and the second highest on record. Average weaning weight was down in 1953 from 1952, but pounds of lamb per ewe bred was the best since 1948.

In 1954, only three Navajo lambs born alive failed to survive to weanling age, and the 97.6 percent lambs weaned of lambs born alive is the highest on record for this breeding group.

THE UNIVERSITY OF MICHIGAN

The University of Michigan is a public research university located in Ann Arbor, Michigan. It was founded in 1817 and is one of the oldest and largest universities in the United States. The university is known for its academic excellence, research contributions, and commitment to public service. It has a long history of producing leaders in various fields, including science, medicine, law, and the arts. The University of Michigan is a member of the Association of American Universities and is ranked among the top universities in the world.

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LAMB PRODUCTION OF NAVAJO MATINGS

Year	No. of Ewes Bred	Percent ^{1/} of Ewes Lambing	Percent of Lambs Born of Ewes Lambing	Percent of Lambs Weaned of Live Lambs Born	Percent of Lambs Weaned of Ewes Bred	Average Weaning Wt. in Pounds	Pounds of Lamb per Ewe Bred
1937-41	1745	88.3	125.2	92.5	97.3	57.0	55.4
1942-46	852	88.6	148.2	84.4	109.7	58.1	63.8
1947	116	84.5	153.1	92.0	117.8	60.5	71.9
1948	115	85.2	163.3	80.4	103.3	57.3	64.4
1949	133	85.0	138.1	80.0	93.2	56.4	52.6
1950	140	61.4	131.4	87.0	68.1	42.4	28.9
1951	156	88.5	108.7	32.9	31.4	32.6	10.2
1947-51	660	80.8	136.8	72.7	79.8	48.8	43.3
1952	173	82.6	129.6	95.6	99.4	59.5	59.1
1953	105	93.5	137.9	93.3	119.1	52.6	62.7
1954	124	88.9	125.0	97.6	100.0	52.2	51.7

^{1/} Percent of ewes lambing of ewes bred for years 1937-1951, but percent of ewes lambing of ewes bred and present at lambing for years 1952-1954.

FACE AND BODY SCORES OF NAVAJO WEANLING LAMBS

The face and body scores of the Navajo weanling lambs from 1947 to 1954 are summarized in the following table. These scores were not taken prior to 1947.

The Navajo weanling lambs are characterized by open faces, clean legs, and poor body type, with a tendency to fatten rather slowly, especially with regard to external fat. The ewe lambs have been consistently better, with regard to type and condition scores, than the ram lambs.

It is doubtful that any trend can be shown in these data in this table since the committees doing the scoring have not been the same from year to year and scoring standards change with different committees. Yearly environmental differences can also influence the type and condition scores as shown by the relatively poor scores taken in 1950 and 1951. This is especially noticeable in the ewe lamb scores.

RAM LAMBS

EWE LAMBS

Year	RAM LAMBS					EWE LAMBS			
	No. of Lambs	Face Covering (score)	Type (score)	Condition (score)		No. of Lambs	Face Covering (score)	Type (score)	Condition (score)
1947	55	2.71	3.50	3.61	:	82	2.72	3.19	3.15
1948	71	2.83	3.10	2.88	:	61	2.76	3.04	2.73
1949	66	2.64	3.09	3.00	:	58	2.65	3.22	2.92
1950	54	2.44	3.36	4.38	:	40	2.33	3.23	4.02
1951	21	2.43	3.49	3.53	:	28	2.52	3.49	3.34
1952	90	2.10	3.68	3.74	:	82	2.03	3.12	3.09
1953	64	2.64	3.09	3.44	:	48	2.48	3.06	3.26
1954	60	2.52	3.08	3.11	:	64	2.59	3.12	3.34
1947-54	481	2.53	3.30	3.44	:	463	2.51	3.16	3.18

FLEECE CHARACTERISTICS OF NAVAJO WEANLING LAMBS

Data on fleece characteristics of the Navajo weanling lambs for the years 1947 through 1954 are summarized in the following table. In 1947, staple length was measured at a constant age of 111 days; in 1951, it was adjusted to a constant age of 120 days; and in all other years, it was measured at 84 days of growth. These differences should be considered in comparing the means of the years given in this table.

Although rigid selection has been practiced against kemp and other medullated fibers, a small number of lambs are encountered each year with an appreciable number of these objectionable fibers. However, in 1953 and, especially, 1954, there were appreciably fewer lambs with medullated fibers than in most previous years.

Outercoat scores in 1953 and 1954 were considerably better than all prior years, and would seem to indicate that some progress is being achieved in eliminating this objectionable fiber from the Navajo fleeces. Fiber diameter appears to be greatly affected by yearly environmental differences. More work needs to be done to determine the causes of these yearly fluctuations in fiber diameter.

Year	No. of Lambs Weaned	Fiber Diameter (microns)	Grade a/	Staple Length (cms.)	Kemp (percent)	Other Med. Fibers (percent)	Outer- coat (score) b/
1947	137	27.8	56s	4.7	0.0	0.4	-
1948	132	28.7	54s	3.4	.3	3.2	3.78
1949	124	29.2	54s	4.1	.2	2.1	3.18
1950	94	28.4	56s	3.3	.3	4.3	3.36
1951	49	25.0	60s	4.2	.0	3.5	3.27
1952	172	29.6	54s	3.6	.7	6.1	3.51
1953	112	31.1	50s	3.4	.0	2.4	2.14
1954	124	25.9	58s	3.6	.9	0.9	2.81
1947-54	944	28.5	56s	3.8	0.3	2.9	3.17

a/ Grade for all years converted to latest ASTM Standards, adopted June, 1953.

b/ Scores for outercoat not taken prior to 1948.

SELECTION PRACTICED ON NAVAJO WEANLING LAMBS

The percentages of Navajo lambs saved, by sex, the selection differentials for most of the economically important traits considered at weaning time, the relative emphasis placed on each trait at culling time, and the expected genetic gains per generation are given in the following table. Heritability estimates for each trait are also included in this table.

Weanling selection differentials represent the average differences between the selected lambs and all lambs weaned, after corrections for environmental effects have been computed. Considerable selection is practiced on rams at later ages, but most of the effective selection of ewes occurs at weanling age. The relative emphasis placed on each trait was obtained by dividing the selection differential by the standard deviation for each trait.

Heritability estimates were obtained for Navajo and Navajo cross-bred lambs for all traits except face covering score, color score, and outercoat score. The heritability estimate for face covering score obtained for range Targhee and Columbia lambs at the U. S. Sheep Experiment Station, Dubois, Idaho has been used to compute the expected genetic gain. Thus the estimate of expected genetic gain per generation for face covering score is accurate only to the extent that the Dubois heritability estimate is representative of the lambs at this station. Heritability estimates for color score and outercoat score have not been computed.

The expected genetic gain per generation for each sex was obtained by multiplying the selection differential times the heritability estimate. The overall expected genetic gain per generation from selection practiced at weanling ages on both sexes was computed by averaging the expected genetic gains of rams and ewes. As fewer ram lambs than ewe lambs are saved, more selection pressure can be exerted against the ram lambs, and it is noticed that most of the expected genetic gain per generation is obtained from the rams. These are relative gains, however, because not all lambs saved at weaning will be used for breeding and not all will produce offspring.

In 1953, 10 ram lambs and 27 ewe lambs were saved from totals of 69 and 48 weaned, respectively. In 1954, 11 ram lambs and 30 ewe lambs were saved from totals of 60 and 64 weaned, respectively. This represents a larger saving of ram lambs, both numerically and percentage wise, than occurred in 1952, but is smaller than in earlier years. Approximately the same percentages of ewe lambs were saved as in the last several years, but less than were saved prior to 1950. Considering the reduced size of the Navajo line and the fact that Navajo sheep are not currently being used in crossbreeding, however, these are relatively larger savings than have occurred in the past. This relatively larger number of lambs saved allows for additional culling at yearling age and allows for the replacement of older ewes with younger ones.

THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and development. It begins with the first settlers who came to the continent in search of a new life. They found a land of vast resources and a people who were eager to learn from them. The story continues through the years of struggle and triumph, from the early days of exploration to the present day.

The story of the United States is a story of the people who have lived on this continent. It is a story of the men and women who have shaped the nation, from the first settlers to the present day. It is a story of the challenges they have faced and the triumphs they have achieved. It is a story of the values that have guided them and the dreams that have inspired them.

The story of the United States is a story of the land that has been called home by so many people. It is a story of the mountains and the valleys, the rivers and the oceans. It is a story of the people who have lived on this land and the things they have done. It is a story of the life that has been lived on this continent and the dreams that have been dreamed.

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The negative selection differentials for staple length and fiber diameter represent selection for lambs with shorter and finer staple. This is a natural consequence of selecting against kemp and outercoat fibers and can be considered an improvement. For all other traits, positive signs indicate genetic gains, while negative signs indicate that the lambs saved were poorer than the average of all lambs in the group from which they were selected.

The greatest emphasis at culling time, for the ram lambs, was placed on outercoat score, condition score, and body weight in 1953, and on condition score, body type score and weight in 1954. For the ewe lambs, the greatest emphasis was placed on condition score, color score, and outercoat score in 1953, and on outercoat score, fiber diameter, and condition score in 1954. No very great expected genetic gains per generation are evident for any trait except weaning weight.

SELECTION PRACTICED ON NAVAJO WEANLING LAMBS

HERITABILITY									
	Weaning Weight (lbs.)	Staple Length (cms.)	Fiber Diameter (microns)	Face Covering (score)	Body Type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
1953	21%	6%	30%	46%*	4%	11%	-	-	
RAMS:									
Selection Differential	3.98	-.17	-.27	.11	.18	.36	.37	.76	15.63
Relative Emphasis	.67	-.28	-.11	.23	.44	.69	.46	1.00	
Expected Genetic Gain	.836	-.010	-.081	.051	.007	.040			
EWES:									
Selection Differential	.41	-.11	-.36	.07	.08	.15	.29	.17	56.25
Relative Emphasis	.08	-.20	-.18	.14	.19	.31	.29	.24	
Expected Genetic Gain	.086	-.007	-.108	.032	.003	.016			
RAMS AND EWES:									
Expected Genetic Gain per Generation	.461	-.008	-.094	.042	.005	.028			
1954									
RAMS:									
Selection Differential	5.48	-.09	-.53	.03	.30	.47	.17	.19	18.33
Relative Emphasis	.69	-.16	-.30	.05	.73	1.07	.17	.21	
Expected Genetic Gain	1.151	-.005	-.159	.014	.012	.052			
EWES:									
Selection Differential	1.44	-.06	.42	.04	.01	.10	.02	.51	46.88
Relative Emphasis	.23	-.10	.27	.09	.02	.24	.02	.50	
Expected Genetic Gain	.302	-.004	.126	.018	.000	.011			
RAMS AND EWES:									
Expected Genetic Gain per Generation	.726	-.004	-.016	.016	.006	.032			

* Heritability estimate for face covering score as obtained for range Targhee and Columbia lambs at the U. S. Sheep Experiment Station, Dubois, Idaho.

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BODY WEIGHTS AND SCORES OF NAVAJO YEARLING RAMS

Year	No. of Rams	Body Weight (lbs.)	Face Covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)	a/
1947	2	115.0	2.25	3.17	3.09	1.50	-	
1948	6	115.2	2.23	3.20	2.96	1.17	-	
1949	14	112.3	2.33	2.89	2.64	1.36	2.24	
1950	10	103.5	2.60	3.00	2.97	1.50	2.07	
1951	9	90.9	2.58	2.67	3.13	1.00	3.60	
1952	2	101.0	1.94	3.06	3.44	1.00	2.00	
1953	8	112.0	1.27	2.90	2.68	1.50	2.63	
1954	10	95.8	1.60	3.65	2.98	1.10	1.48	
1947-54	61	105.0	2.13	3.05	2.90	1.28	2.35	

a/ Scores for outercoat not taken prior to 1949.

Body weight and condition scores in 1953 were the best since 1949, and were well above the 1947-1954 average. Type and outercoat scores for the same year were approximately average. In 1954, body weight and type and condition scores declined considerably from the 1953 high, but outercoat score was by far the best on record. Face covering score has been well above the average for the past three years. Selection against color of face and legs continues, but there are still a considerable number of animals each year that have some degree of color.

FLEECE CHARACTERISTICS OF NAVAJO YEARLING RAMS

The fleece characteristics of all Navajo yearling rams from 1947 through 1954 are summarized in the following table. The fleeces of all rams have been free of kemp fibers as far as this can be determined from laboratory tests. Selection against kemp, other medullated fibers, and coarse outercoat fibers has improved the quality of the fleeces, but at the same time it has reduced the effectiveness of selection for fleece weight and staple length.

Year	No. of Rams	Fleece Weights		Fiber Traits at Side			
		Grease (lbs.)	Clean (lbs.)	Fiber Diameter (microns)	Grade*	Staple Length (cms.)	Medullated Fibers (percent)
1947	2	7.18	4.70	33.6	46s	14.8	0.0
1948	6	6.65	3.88	32.0	48s	15.0	1.2
1949	14	6.43	4.30	28.8	54s	11.6	.1
1950	10	6.56	3.92	28.1	56s	12.6	.0
1951	9	5.82	3.32	30.0	54s	12.8	2.1
1952	2	5.39	3.07	29.1	54s	9.5	.0
1953	8	5.09	3.20	30.3	50s	10.4	.0
1954	10	3.95	2.72	23.6	62s	7.8	.0
1947-54	61	5.79	3.59	28.7	54s	11.5	0.5

* Grade for all years converted to latest ASTM Standards, adopted June, 1953.

BODY WEIGHTS AND SCORES OF NAVAJO YEARLING EWES

Body weight and type and condition scores of the Navajo yearling ewes were below average for both 1953 and 1954, and no doubt reflect the effects of adverse winter range feed conditions between weanling and yearling ages. These three traits were adjusted in 1954 for the effects of age of dam, type of birth and rearing, and to a constant age of 400 days - the average age when these measurements were recorded. All previous years are on the basis of unadjusted data.

Face covering score has been consistently above average for the past three years and probably represents a genetic gain, while color score is slightly above average in 1953 and 1954. Outercoat score was the best on record in 1954, but was the second poorest in 1953.

Year	No. of Ewes	Body Weight (lbs.)	Face Covering (score)	Type (score)	Condition (score)	Color (score)	Outer- coat (score)	a/
1947	39	84.6	2.07	3.29	3.13	2.46	-	
1948	75	86.8	2.58	2.97	2.68	1.32	-	
1949	55	77.9	2.31	2.74	2.49	1.72	3.08	
1950	46	75.7	2.43	2.84	2.91	1.30	3.05	
1951	26	46.6	2.51	3.35	3.20	1.88	3.38	
1952	11	75.4	1.92	3.06	3.22	2.39	3.91	
1953	40	67.6	1.65	3.08	3.13	1.58	3.61	
1954	27	73.1	1.93	3.24	2.91	1.26	2.50	
1947-54	319	76.2	2.25	3.02	2.87	1.64	3.18	

a/ Scores for outercoat not taken prior to 1949.

FLEECE CHARACTERISTICS OF NAVAJO YEARLING EWES

Staple length and grease fleece and clean fleece weights of the Navajo yearling ewes were below average in both 1953 and 1954. This, no doubt, is partly due to adverse winter range feed conditions during the months immediately preceding shearing and sampling, and it may also be the result, in part, of selection against outercoat, kemp, and other medullated fibers. Staple length and grease and clean fleece weights were adjusted in 1953 and 1954 to a constant age of 365 days and for the effects of age of dam and type of birth and rearing. All previous years are on the basis of unadjusted data. The incidence of kemp and other medullated fibers, two traits less affected by environmental conditions, show improvement over previous years. As these objectionable fibers are eliminated, more emphasis can be placed on improving fleece weights.

Year	No. of Ewes	Fleece Weights		Fiber Diameter (microns)	Grade*	Staple Length (cms.)	Kemp (percent)	Other Medullated Fibers (percent)
		Grease (lbs.)	Clean (lbs.)					
1947	39	5.14	4.00	31.6	50s	11.4	0.1	3.0
1948	75	6.19	3.82	28.1	56s	12.5	.2	1.1
1949	55	5.73	3.69	26.0	58s	10.5	.5	3.0
1950	46	6.38	3.38	26.1	58s	11.4	.1	1.6
1951	26	3.27	1.75	21.4	64s	10.2	.1	.9
1952	11	5.14	2.77	28.9	54s	9.1	.0	.7
1953	40	4.57	2.99	26.2	58s	10.6	.3	.8
1954	27	4.31	2.91	24.8	60s	8.8	.0	.1
1947-54	319	5.37	3.37	26.8	58s	11.0	0.2	1.6

* Grade for all years converted to latest ASTM Standards, adopted June, 1953.

THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. It begins with the first settlers who came to the Americas, and continues through the years of exploration, settlement, and the struggle for independence. The story is one of a people who have built a great nation from a small group of pioneers. The history of the United States is a story of the triumph of the human spirit over adversity, and of the power of unity and cooperation. It is a story of a people who have made a great contribution to the world, and who continue to shape the future of the nation.

Year	Event	Location	Significance
1492	Columbus discovers America	Santa Lucia, Spain	First European contact with the Americas
1607	First English settlement in America	Jamestown, Virginia	First permanent English colony in North America
1776	Declaration of Independence	Philadelphia, Pennsylvania	United States becomes an independent nation
1789	Constitution signed	Philadelphia, Pennsylvania	United States becomes a constitutional republic
1862	Emancipation Proclamation	Washington, D.C.	Slavery is abolished in the United States
1898	Spanish-American War	San Juan, Puerto Rico	United States becomes a world power
1914	World War I	Europe	United States enters the war
1945	World War II	Europe and Asia	United States emerges as a superpower
1954	Civil Rights Act	Washington, D.C.	Segregation is outlawed
1964	Great Society	Washington, D.C.	War on Poverty and Social Security
1973	Watergate Scandal	Washington, D.C.	President Nixon resigns
1981	AIDS discovered	New York City	First case of AIDS reported
1989	Wall falls	Berlin	End of the Cold War
1991	Gulf War	Gulf of Persia	United States leads coalition against Iraq
1993	NATO expands	Europe	United States leads NATO
1997	Clinton impeached	Washington, D.C.	First impeachment of a President
1998	Norfolk School Shooting	Norfolk, Virginia	First mass shooting in a school
1999	Clinton impeached	Washington, D.C.	Second impeachment of a President
2001	9/11 attacks	New York City	First terrorist attacks on the United States
2002	Afghanistan War	Afghanistan	United States leads coalition against Taliban
2003	Iraq War	Iraq	United States leads coalition against Saddam Hussein
2008	Financial Crisis	Global	First financial crisis since the Great Depression
2009	Obama elected	Washington, D.C.	First African American President
2010	Healthcare Reform	Washington, D.C.	First major healthcare reform since 1965
2011	Arab Spring	Middle East	First major conflict since the 1990s
2012	Sequester	Washington, D.C.	First major budget crisis since the 1980s
2013	Syrian Civil War	Syria	First major conflict since the 1990s
2014	Eurozone Crisis	Europe	First major financial crisis since the 1990s
2015	Paris Agreement	Paris, France	First major climate agreement since the 1990s
2016	Trump elected	Washington, D.C.	First President since 1980
2017	Trade Wars	Global	First major trade conflict since the 1990s
2018	North Korea Crisis	North Korea	First major conflict since the 1990s
2019	COVID-19	Global	First major pandemic since the 1960s
2020	Black Lives Matter	Global	First major social movement since the 1960s
2021	January 6th	Washington, D.C.	First major political crisis since the 1960s
2022	Russia-Ukraine War	Ukraine	First major conflict since the 1990s
2023	AI Revolution	Global	First major technological revolution since the 1980s
2024	Climate Change	Global	First major environmental crisis since the 1960s
2025	Space Exploration	Space	First major space exploration since the 1960s
2026	Quantum Computing	Global	First major technological revolution since the 1980s
2027	Autonomous Vehicles	Global	First major technological revolution since the 1980s
2028	Artificial Intelligence	Global	First major technological revolution since the 1980s
2029	Space Colonization	Space	First major space exploration since the 1960s
2030	Climate Change	Global	First major environmental crisis since the 1960s

The history of the United States is a story of growth and change. It begins with the first settlers who came to the Americas, and continues through the years of exploration, settlement, and the struggle for independence. The story is one of a people who have built a great nation from a small group of pioneers. The history of the United States is a story of the triumph of the human spirit over adversity, and of the power of unity and cooperation. It is a story of a people who have made a great contribution to the world, and who continue to shape the future of the nation.

RESEARCH PROJECT 2

IMPROVEMENT OF NAVAJO SHEEP BY CROSSBREEDING AND SELECTION FOR THE PRODUCTION OF WOOL SUITABLE FOR BOTH HAND AND COMMERCIAL METHODS OF MANUFACTURE.

The objective of this research project is the development of coarse-wooled strains of sheep that combine adaptability to southwestern ranges with efficient production of good quality feeder lambs and wool of 46s, 48s and 50s grades. Selection emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

Information on the characteristics and production of the sheep used in project 2 are presented in this section.

CHARACTERISTICS OF COARSE WOOL, CROSSBRED BREEDING RAMS

Various characteristics of the breeding rams used in research project 2 are presented in the following table. Since breeding groups 2, 3, 6, and 7, which consisted of purebred rams mated to Navajo or Navajo crossbred ewes, were discontinued in 1951, the totals given for 1950 include only those rams used in breeding groups 8, 9, 10, 11, and 16. Data for years prior to 1950 are not presented because the matings consisted largely of purebred rams mated to Navajo or Navajo crossbred ewes. The breeding of the rams in each group is given in the outline of breeding program at the beginning of this report. Fleece characteristics considered are grade, staple length, uniformity, freedom from kemp and other medullated fibers, and yield of grease and clean wool.

The breeding rams used in the 1953 and 1954 seasons had body weights and clean fleece weights superior to the rams used in 1952, but not equal to the 1950 and 1951 averages for these traits. Grease fleece weights and staple lengths were approximately the same in 1953 and 1954 as they were in 1952, which was considerably less than in 1950 and 1951. The percentage of medullated fibers was reduced in 1953 and completely eliminated in 1954.

CHARACTERISTICS OF COARSEWOOL, CROSSBRED BREEDING RAMS

Year and Breeding Group No.	No. of Rams	Age of Rams at Lambing (years)	Body Weight at Breeding (lbs.)	Fleece Weights as Yearlings		Yearling Fiber Traits at Side		
				Grease (lbs.)	Clean (lbs.)	Grade*	Staple Length (cms.)	Med. Fibers (percent)
1950	15	2.4	178.9	10.48	6.97	48s	12.67	.04
1951	18	2.5	181.4	10.31	5.79	50s	12.77	.06
1952	16	2.9	165.9	8.92	4.73	50s	11.96	.15
<hr/>								
1950-52	49	2.6	175.6	9.91	5.81	50s	12.47	.08
<hr/>								
1953 Group								
8	2	4.5	205.5	9.85	5.93	48s	13.0	.52
9	2	3.5	187.0	9.02	4.28	56s	11.0	.00
10	3	3.7	176.3	8.93	5.00	54s	12.7	.00
11	1	5.0	199.0	11.45	7.20	46s	13.5	.00
16	4	2.2	148.8	7.50	4.41	50s	10.8	.00
Totals & Averages	12	3.4	175.7	8.83	5.02	50s	11.9	0.09
<hr/>								
1954 Group								
8	2	4.5	182.5	9.35	4.64	48s	11.8	0.0
9	1	4.0	198.0	7.75	3.46	56s	10.8	0.0
10	2	5.0	191.0	9.00	5.16	54s	12.8	0.0
11	1	6.0	172.0	11.45	7.20	46s	13.5	0.0
16	7	2.6	154.7	8.55	5.05	50s	11.8	0.0
Totals & Averages	13	3.6	169.2	8.90	5.05	50s	12.0	0.0

* Grade for 1953-54 based on latest ASTM Standards, adopted June, 1953.

THE HISTORY OF THE UNITED STATES OF AMERICA

CHAPTER I		CHAPTER II		CHAPTER III		CHAPTER IV	
1776	1777	1778	1779	1780	1781	1782	1783
1784	1785	1786	1787	1788	1789	1790	1791
1792	1793	1794	1795	1796	1797	1798	1799
1800	1801	1802	1803	1804	1805	1806	1807
1808	1809	1810	1811	1812	1813	1814	1815
1816	1817	1818	1819	1820	1821	1822	1823
1824	1825	1826	1827	1828	1829	1830	1831
1832	1833	1834	1835	1836	1837	1838	1839
1840	1841	1842	1843	1844	1845	1846	1847
1848	1849	1850	1851	1852	1853	1854	1855
1856	1857	1858	1859	1860	1861	1862	1863
1864	1865	1866	1867	1868	1869	1870	1871
1872	1873	1874	1875	1876	1877	1878	1879
1880	1881	1882	1883	1884	1885	1886	1887
1888	1889	1890	1891	1892	1893	1894	1895
1896	1897	1898	1899	1900	1901	1902	1903
1904	1905	1906	1907	1908	1909	1910	1911
1912	1913	1914	1915	1916	1917	1918	1919
1920	1921	1922	1923	1924	1925	1926	1927
1928	1929	1930	1931	1932	1933	1934	1935
1936	1937	1938	1939	1940	1941	1942	1943
1944	1945	1946	1947	1948	1949	1950	1951
1952	1953	1954	1955	1956	1957	1958	1959
1960	1961	1962	1963	1964	1965	1966	1967
1968	1969	1970	1971	1972	1973	1974	1975
1976	1977	1978	1979	1980	1981	1982	1983
1984	1985	1986	1987	1988	1989	1990	1991
1992	1993	1994	1995	1996	1997	1998	1999
2000	2001	2002	2003	2004	2005	2006	2007
2008	2009	2010	2011	2012	2013	2014	2015
2016	2017	2018	2019	2020	2021	2022	2023
2024	2025	2026	2027	2028	2029	2030	2031
2032	2033	2034	2035	2036	2037	2038	2039
2040	2041	2042	2043	2044	2045	2046	2047
2048	2049	2050	2051	2052	2053	2054	2055
2056	2057	2058	2059	2060	2061	2062	2063
2064	2065	2066	2067	2068	2069	2070	2071
2072	2073	2074	2075	2076	2077	2078	2079
2080	2081	2082	2083	2084	2085	2086	2087
2088	2089	2090	2091	2092	2093	2094	2095
2096	2097	2098	2099	2100	2101	2102	2103
2104	2105	2106	2107	2108	2109	2110	2111
2112	2113	2114	2115	2116	2117	2118	2119
2120	2121	2122	2123	2124	2125	2126	2127
2128	2129	2130	2131	2132	2133	2134	2135
2136	2137	2138	2139	2140	2141	2142	2143
2144	2145	2146	2147	2148	2149	2150	2151
2152	2153	2154	2155	2156	2157	2158	2159
2160	2161	2162	2163	2164	2165	2166	2167
2168	2169	2170	2171	2172	2173	2174	2175
2176	2177	2178	2179	2180	2181	2182	2183
2184	2185	2186	2187	2188	2189	2190	2191
2192	2193	2194	2195	2196	2197	2198	2199
2200	2201	2202	2203	2204	2205	2206	2207
2208	2209	2210	2211	2212	2213	2214	2215
2216	2217	2218	2219	2220	2221	2222	2223
2224	2225	2226	2227	2228	2229	2230	2231
2232	2233	2234	2235	2236	2237	2238	2239
2240	2241	2242	2243	2244	2245	2246	2247
2248	2249	2250	2251	2252	2253	2254	2255
2256	2257	2258	2259	2260	2261	2262	2263
2264	2265	2266	2267	2268	2269	2270	2271
2272	2273	2274	2275	2276	2277	2278	2279
2280	2281	2282	2283	2284	2285	2286	2287
2288	2289	2290	2291	2292	2293	2294	2295
2296	2297	2298	2299	2300	2301	2302	2303
2304	2305	2306	2307	2308	2309	2310	2311
2312	2313	2314	2315	2316	2317	2318	2319
2320	2321	2322	2323	2324	2325	2326	2327
2328	2329	2330	2331	2332	2333	2334	2335
2336	2337	2338	2339	2340	2341	2342	2343
2344	2345	2346	2347	2348	2349	2350	2351
2352	2353	2354	2355	2356	2357	2358	2359
2360	2361	2362	2363	2364	2365	2366	2367
2368	2369	2370	2371	2372	2373	2374	2375
2376	2377	2378	2379	2380	2381	2382	2383
2384	2385	2386	2387	2388	2389	2390	2391
2392	2393	2394	2395	2396	2397	2398	2399
2400	2401	2402	2403	2404	2405	2406	2407
2408	2409	2410	2411	2412	2413	2414	2415
2416	2417	2418	2419	2420	2421	2422	2423
2424	2425	2426	2427	2428	2429	2430	2431
2432	2433	2434	2435	2436	2437	2438	2439
2440	2441	2442	2443	2444	2445	2446	2447
2448	2449	2450	2451	2452	2453	2454	2455
2456	2457	2458	2459	2460	2461	2462	2463
2464	2465	2466	2467	2468	2469	2470	2471
2472	2473	2474	2475	2476	2477	2478	2479
2480	2481	2482	2483	2484	2485	2486	2487
2488	2489	2490	2491	2492	2493	2494	2495
2496	2497	2498	2499	2500	2501	2502	2503
2504	2505	2506	2507	2508	2509	2510	2511
2512	2513	2514	2515	2516	2517	2518	2519
2520	2521	2522	2523	2524	2525	2526	2527
2528	2529	2530	2531	2532	2533	2534	2535
2536	2537	2538	2539	2540	2541	2542	2543
2544	2545	2546	2547	2548	2549	2550	2551
2552	2553	2554	2555	2556	2557	2558	2559
2560	2561	2562	2563	2564	2565	2566	2567
2568	2569	2570	2571	2572	2573	2574	2575
2576	2577	2578	2579	2580	2581	2582	2583
2584	2585	2586	2587	2588	2589	2590	2591
2592	2593	2594	2595	2596	2597	2598	2599
2600	2601	2602	2603	2604	2605	2606	2607
2608	2609	2610	2611	2612	2613	2614	2615
2616	2617	2618	2619	2620	2621	2622	2623
2624	2625	2626	2627	2628	2629	2630	2631
2632	2633	2634	2635	2636	2637	2638	2639
2640	2641	2642	2643	2644	2645	2646	2647
2648	2649	2650	2651	2652	2653	2654	2655
2656	2657	2658	2659	2660	2661	2662	2663
2664	2665	2666	2667	2668	2669	2670	2671
2672	2673	2674	2675	2676	2677	2678	2679
2680	2681	2682	2683	2684	2685	2686	2687
2688	2689	2690	2691	2692	2693	2694	2695
2696	2697	2698	2699	2700	2701	2702	2703
2704	2705	2706	2707	2708	2709	2710	2711
2712	2713	2714	2715	2716	2717	2718	2719
2720	2721	2722	2723	2724	2725	2726	2727
2728	2729	2730	2731	2732	2733	2734	2735
2736	2737	2738	2739	2740	2741	2742	2743
2744	2745	2746	2747	2748	2749	2750	2751
2752	2753	2754	2755	2756	2757	2758	2759
2760	2761	2762	2763	2764	2765	2766	2767
2768	2769	2770	2771	2772	2773	2774	2775
2776	2777	2778	2779	2780	2781	2782	2783
2784	2785	2786	2787	2788	2789	2790	2791
2792	2793	2794	2795	2796	2797	2798	2799
2800	2801	2802	2803	2804	2805	2806	2807
2808	2809	2810	2811	2812	2813	2814	2815
2816	2817	2818	2819	2820	2821	2822	2823
2824	2825	2826	2827	2828	2829	2830	2831
2832	2833	2834	2835	2836	2837	2838	2839
2840	2841	2842	2843	2844	2845	2846	2847
2848	2849	2850	2851	2852	2853	2854	2855
2856	2857	2858	2859	2860	2861	2862	2863
2864	2865	2866	2867	2868	2869	2870	2871
2872	2873	2874	2875	2876	2877	2878	2879
2880	2881	2882	2883	2884	2885	2886	2887
2888	2889	2890	2891	2892	2893	2894	2895
2896	2897	2898	2899	2900	2901	2902	2903
2904	2905	2906	2907	2908	2909	2910	2911
2912	2913	2914	2915	2916	2917	2918	2919
2920	2921	2922	2923	2924	2925	2926	2927
2928	2929	2930	2931	2932	2933	2934	2935
2936	2937	2938	2939	2940	2941	2942	2943
2944	2945	2946	2947	2948	2949	2950	2951
2952	2953	2954	2955	2956	2957	2958	2959
2960	2961	2962	2963	2964	2965	2966	2967
2968	2969	2970	2971	2972	2973	2974	2975
2976	2977	2978	2979	2980	2981	2982	2983
2984	2985	2986	2987	2988	2989	2990	2991
2992	2993	2994	2995	2996	2997	2998	2999
3000	3001	3002	3003	3004	3005	3006	3007
3008	3009	3010	3011	3012	3013	3014	3015
3016	3017	3018	3019	3020	3021	3022	3023
3024	3025	302					

CHARACTERISTICS OF COARSEWOOL, CROSSBRED BREEDING EWES

Average age of the ewes at lambing, body weight at 18 months, and yearling fleece characteristics of the breeding ewes in research project 2 are summarized by their respective breeding groups in the following table. Since breeding groups 2, 3, 6, and 7, which consisted of purebred rams mated to Navajo or Navajo crossbred ewes, were discontinued in 1951, the totals given for 1950 include only those ewes assigned to breeding groups 8, 9, 10, 11, and 16. Data for prior years are not presented as they consisted largely of above mentioned types of matings. Average age at lambing has increased in groups 8, 9, 10 and 11 because young replacement ewes for these groups are no longer being produced.

Fleece grade appears to grow increasingly finer from 1950 to 1952, and then to level off with the 1952 grade maintained in 1953 and 1954. It has been noticed, however, that there are considerable yearly variations in grade that seem to reflect fluctuations in feed conditions. Since the fleece samples are taken in early April and are cross-sectioned proportionally about one-fourth the distance from the base of the lock, the fiber diameter determinations are representative of wool grown during the winter months when range feed conditions are low and variable. It is doubtful if this apparent increase in fineness represents a genetic change.

The percentage of medullated fibers at side has decreased steadily since 1950 and probably represents a genetic gain. Kemp fibers have amounted to less than 0.01 percent of total fibers for the past five years and are no longer reported. The percentages of kemp and other medullated fibers were slightly higher at the thigh position than at the side.

Clean fleece weights show improvement over 1952, but are not equal to prior years, while grease fleece weights and body weights at 18 months are more variable. Average staple length for all breeding groups has remained fairly constant over the past five years.

CHARACTERISTICS OF COARSEWOOL, CROSSBRED BREEDING EWES

Year and Breeding Group No.	No. of Ewes	Age of Ewes at Lambing (years)	Body Weight at 18 Months (lbs.)	Fleece Weights as Yearlings		Yearling Fiber Traits at Side		
				Grease (lbs.)	Clean (lbs.)	Grade*	Staple Length (cms.)	Med. Fibers (percent)
1950	501	2.7	114.9	7.43	4.51	56s	11.1	1.74
1951	612	3.2	109.4	7.58	4.29	58s	11.3	1.27
1952	553	3.6	102.0	6.83	3.27	60s	11.2	0.98
1950-52	1666	3.2	108.6	7.29	4.02	58s	11.2	1.32
1953 Group								
8	60	5.1	113.0	8.07	4.52	60s	10.7	0.99
9	38	4.6	103.9	7.71	4.56	58s	13.2	1.46
10	68	4.8	109.2	7.66	4.75	58s	11.6	0.65
11	30	4.7	103.0	7.15	3.94	58s	10.0	1.02
16	102	3.0	94.7	6.25	3.46	60s	11.0	0.34
Totals & Averages	298	4.2	103.8	7.23	4.16	60s	11.3	0.75
1954 Group								
8	46	6.0	113.1	8.12	4.54	60s	10.7	0.92
9	29	5.3	99.7	7.54	4.41	60s	12.8	1.23
10	55	5.8	109.1	7.55	4.73	58s	11.5	0.54
11	28	5.8	101.4	6.93	3.84	58s	9.9	0.96
16	185	3.0	96.8	5.97	3.71	60s	10.7	0.19
Totals & Averages	343	4.3	101.6	6.73	4.05	60s	10.9	0.49

* Grade for 1953 and 1954 based on latest ASTM Standards, adopted June, 1953.

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LAMB PRODUCTION OF COARSEWOOL CROSSBRED MATINGS

Lamb production of the ewes in research project 2 is summarized by breeding groups for 1953 and 1954 in the following table. The lamb production is summarized for 1952 and by five year periods for 1937-41, 1942-46, and 1947-51. The bulk of the matings for the three 5-year periods consisted of purebred rams of several breeds mated to Navajo or first and second cross Navajo ewes. For this reason the 1937-51 data are not directly comparable with the data for the last three years.

The percent of ewes lambing was based on numbers of ewes bred for the years 1937-51, but beginning in 1952, it is based on the number of ewes bred and still present (surviving) at lambing time. The more recent method of computation gives an indication of fertility that is not confounded by post-breeding death losses. This percentage is affected by the fertility of both the rams and the ewes. Percent of lambs born of ewes lambing minus 100 gives the percentage of ewes having twin lambs. The percent of lambs weaned of live lambs born is a measure of lamb mortality. Average weaning weight and pounds of lamb per ewe bred for the years 1937-1946 are based on weights taken at about 140 days of age and unadjusted for any of the measurable environmental factors. Beginning in 1947 the weights are adjusted to a constant age of 120 days and are corrected for type of birth and rearing of the lamb and age of the dam.

For 1953, one of the ewes in group 9, three in group 11, and three in group 16 were discovered to have been accidentally range bred prior to the regular breeding season and were, therefore, omitted when computing the various percentages. In addition, four ewes each in groups 8 and 10, one ewe in group 9, and six ewes in group 16 died or were missing between breeding and lambing times. In group 8, one of the two rams used was of low fertility. Of the 30 ewes to which he was mated, 6 lambed, 18 were range bred, 4 were dry and 2 died. In group 10, one of the three rams used proved to be completely sterile, as none of the 22 ewes to which he was mated lambed. The failure of these two rams to breed satisfactorily is responsible for the low percentage of ewes lambing, percent of lambs weaned of ewes bred, and pounds of lamb per ewe bred for groups 8 and 10. In other respects, 1953 was an average year for lamb production with none of the traits being exceptionally high or low. Average weaning weight was lower than any of the previous 5-year averages, but not as low as some of the individual years (1950 and 1951 in particular) that make up the five year averages.

For 1954, two ewes each in groups 8, 11, and 16 and three ewes each in groups 9 and 10 died or were missing between breeding and lambing times. Five dry ewes and two range bred ewes account for the low percentage of ewes lambing in group 11. In group 16, one of the

LAMB PRODUCTION OF COARSEWOOL CROSSBRED MATINGS, Continued.

seven rams used was infertile. Of the 27 ewes bred to this ram, only two lambed. Both of the lambs were born dead and mummified. The percent of lambs weaned of live lambs born and the average weaning weight generally reflect fairly closely the range feed conditions for the June to September period. These two traits averaged better in 1954 than in the extremely dry years of 1950 and 1951, but they were inferior to years when range forage was more plentiful.

Year and Breeding Group No.	No. of Ewes Bred	Percent* of Ewes Lambing	Percent Lambs Born of Ewes Lambing	Percent Lambs Weaned of Live Lambs Born	Percent Lambs Weaned of Ewes Bred	Average Weaning Weight (lbs.)	Pounds of Lamb per Ewe Bred
1937-41	1216	88.3	126.0	88.8	97.1	59.9	58.2
1942-46	1794	79.8	140.6	81.3	89.4	59.4	53.1
1947-51	3864	79.4	129.0	76.2	76.6	57.9	44.3
1952	553	92.3	113.2	87.1	89.3	66.2	59.1
1953 Group							
8	60	58.9	154.5	85.7	70.0	54.4	38.1
9	38	97.2	142.9	85.4	110.8	58.3	64.6
10	68	60.9	141.0	90.9	73.5	56.8	41.8
11	30	100.0	118.5	90.3	103.7	55.8	57.9
16	102	97.8	124.2	86.5	97.0	55.7	54.0
Totals & Averages	298	81.5	133.8	87.4	88.3	56.1	49.6
1954 Group							
8	46	90.9	123.5	75.5	87.0	56.3	48.9
9	29	96.2	120.0	90.0	93.1	58.0	54.0
10	55	94.2	118.4	69.6	70.9	54.0	38.3
11	28	73.1	126.3	77.3	60.7	57.5	34.9
16	185	80.9	114.9	85.6	74.1	53.8	39.8
Totals & Averages	343	84.9	119.2	81.0	75.8	54.9	41.6

* Percent of ewes lambing of ewes bred for years 1937-1951, but percent of ewes lambing of ewes bred and still present at lambing for years 1952-1954.

FACE AND BODY SCORES OF COARSEWOOL CROSSBRED WEANLING LAMBS

In the following table, face and body scores of the coarsewool weanling lambs are summarized by sex and breeding group for 1953 and 1954, and by yearly averages by sex for the years 1949 through 1952.

Averages of the three scores indicate little difference between groups. In general, the scores for 1953 and 1954 were better than those for the extremely droughty years of 1950 and 1951, but were not equal to the better years of 1949 and 1952. Ram lambs had slightly better condition scores than the ewe lambs in 1953 and 1954. Type scores were about the same for both sexes in 1954, while the ram lambs were slightly better than the ewe lambs in this respect in 1953. Both sexes appeared to have somewhat more face covering in 1953 and 1954 than they have shown for several years.

RAM LAMBS

Year and Breeding Group No.	No. of Lambs	Face Covering Score	Type Score	Condition Score		No. of Lambs	Face Covering Score	Type Score	Condition Score
1949	311	3.04	2.45	2.51	:	318	2.98	2.57	2.49
1950	358	2.99	2.94	3.97	:	362	2.85	2.88	3.85
1951	133	2.70	3.14	3.26	:	117	2.63	3.18	3.25
1952	249	2.34	2.81	3.40	:	244	2.24	2.41	2.59
1949-52 Totals & Averages	1051	2.81	2.79	3.31	:	1041	2.72	2.71	3.07
1953 Group					:				
8	21	3.24	2.92	3.36	:	21	3.05	2.80	2.97
9	23	2.61	2.59	2.97	:	18	2.67	2.88	3.00
10	28	2.95	2.77	3.09	:	22	2.50	2.86	3.01
11	13	2.97	2.52	2.91	:	15	2.82	2.68	2.81
16	54	2.92	2.62	2.99	:	42	2.84	2.80	2.97
Totals & Averages	139	2.92	2.68	3.06	:	118	2.78	2.81	2.96
1954 Group					:				
8	19	3.19	2.77	3.02	:	21	2.97	2.79	2.96
9	13	3.15	2.63	2.80	:	14	2.83	2.98	3.16
10	20	2.75	2.89	3.06	:	19	2.91	2.75	2.89
11	12	2.86	2.62	2.93	:	5	2.93	2.72	3.09
16	67	3.07	2.77	3.04	:	70	2.91	2.67	2.94
Totals & Averages	131	3.03	2.76	3.01	:	129	2.91	2.74	2.97

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The following table shows the results of the experiments conducted on the effect of the concentration of the solution on the rate of reaction. The rate of reaction was measured by the volume of gas evolved per unit time. The concentration of the solution was varied from 0.1 M to 0.5 M. The results show that the rate of reaction increases with increasing concentration of the solution.

Concentration (M)	Rate of Reaction (ml/min)	Time (min)	Volume of Gas (ml)	Concentration (M)	Rate of Reaction (ml/min)	Time (min)	Volume of Gas (ml)
0.1	1.2	10	12	0.2	2.4	10	24
0.2	2.4	10	24	0.3	3.6	10	36
0.3	3.6	10	36	0.4	4.8	10	48
0.4	4.8	10	48	0.5	6.0	10	60
0.5	6.0	10	60				
0.1	1.2	20	24	0.2	2.4	20	48
0.2	2.4	20	48	0.3	3.6	20	72
0.3	3.6	20	72	0.4	4.8	20	96
0.4	4.8	20	96	0.5	6.0	20	120
0.5	6.0	20	120				
0.1	1.2	30	36	0.2	2.4	30	72
0.2	2.4	30	72	0.3	3.6	30	108
0.3	3.6	30	108	0.4	4.8	30	144
0.4	4.8	30	144	0.5	6.0	30	180
0.5	6.0	30	180				
0.1	1.2	40	48	0.2	2.4	40	96
0.2	2.4	40	96	0.3	3.6	40	144
0.3	3.6	40	144	0.4	4.8	40	192
0.4	4.8	40	192	0.5	6.0	40	240
0.5	6.0	40	240				
0.1	1.2	50	60	0.2	2.4	50	120
0.2	2.4	50	120	0.3	3.6	50	180
0.3	3.6	50	180	0.4	4.8	50	240
0.4	4.8	50	240	0.5	6.0	50	300
0.5	6.0	50	300				

FLEECE CHARACTERISTICS OF COARSEWOOL, CROSSBRED WEANLING LAMBS

The following table summarizes the fiber characteristics at side of the coarsewool weanling lambs in research project 2, by years, for 1949 through 1952, and by years and breeding groups for 1953 and 1954. Fiber diameter and grade show the greatest variation between years, but are relatively uniform between breeding groups within years. Group 11 had the smallest percentage of medullated fibers in 1953 and 1954, and was the only group to be completely free of kemp fibers in both years. Outercoat score and percentage of other medullated fibers show improvement in both 1953 and 1954 over prior years, with 1953 being the better of the two for both traits.

Year and Breeding Group No.	No. of Lambs	Fiber Diameter	Grade*	Staple Length (cms.)	Kemp (percent)	Other Med. Fibers (percent)	Outercoat Score
1949	628	28.7	54s	4.30	0.20	3.29	2.96
1950	720	27.0	58s	3.90	0.10	3.76	2.97
1951	250	25.5	60s	4.20	0.08	2.19	2.97
1952	493	28.3	56s	4.18	0.10	2.89	2.81
1949-52 Totals & Averages	2091	27.6	56s	4.12	0.13	3.23	2.98
1953 Group							
8	42	31.1	50s	4.32	0.06	3.49	2.19
9	41	30.4	50s	4.06	0.00	1.92	1.91
10	50	31.2	50s	3.99	0.00	0.81	1.83
11	28	31.3	50s	4.35	0.00	0.14	1.74
16	96	31.2	50s	3.99	0.00	1.58	1.94
Totals & Averages	257	31.1	50s	4.10	0.01	1.63	1.93
1954 Group							
8	40	26.6	58s	4.38	0.29	2.25	2.78
9	27	25.8	58s	3.86	0.34	4.52	2.00
10	39	26.3	58s	4.20	0.06	1.35	2.62
11	17	26.3	58s	4.11	0.00	0.09	2.61
16	137	26.0	58s	4.20	0.32	1.74	2.50
Totals & Averages	260	26.2	58s	4.19	0.26	1.94	2.51

* Grade for all years converted to latest ASTM Standards, adopted June 1953.

SELECTION PRACTICED ON COARSEWOOL, CROSSBRED WEANLING LAMBS

The selection differentials, relative emphasis and expected genetic gains per generation for the weanling lambs in research project 2 are given in the following table.

Weanling selection differentials are the average difference between the lambs saved and the total lambs weaned. It is important that these selection differentials be as large as possible since, for economic reasons, most of the effective selection must be accomplished at weanling age. This is especially true of the ewe lambs.

The relative emphasis placed on each trait at culling time is computed by dividing the selection differential by the standard deviation of that trait. The expected genetic gain was computed by multiplying the selection differential by the heritability estimate. The use of one half heritability times the selection differential for each sex and the sum of these products (or the average of the expected genetic gain as given in the table) gives the expected genetic gain per generation from selection practiced at weaning age on both sexes. By dividing these figures by the generation interval (average age of the sire and dam when lambs are born) the expected genetic gain per year is obtained. To be correct, the generation interval which should be applied to these data would be the age when these lambs produce offspring. Since this information is not available, it can only be estimated now from the average age of the present parents. It should also be pointed out that these gains from selection are only relative since all lambs saved at weaning will not produce progeny.

In general, the most emphasis has been placed on weaning weight and body type, condition, and outercoat scores. Selection differentials, relative emphasis and expected genetic gains for both sexes for weaning weight were larger in 1954 than in 1953. The selection differential and relative emphasis for outercoat score in ram lambs were also larger in 1954 than in 1953, while fiber diameter showed slightly larger gains in 1953. For most of the other traits there was little difference between the two years. In all traits most of the gains came through selection of the rams. Selection against outercoat and medullated fibers has resulted in slight selection pressure against staple length and fiber diameter in some instances.

Since an heritability estimate for face covering score has not been computed at this Station, the value obtained for range Targhee and Columbia lambs at Dubois, Idaho has been used. Thus the estimate for expected genetic gain is only accurate to the extent that the Dubois heritability is representative of the lambs at this Station.

In 1953, 31 ram lambs and 70 ewe lambs were saved from totals of 134 and 118 weaned, respectively. From totals of 126 ram lambs and 123 ewe lambs weaned in 1954, 32 and 59 were saved, respectively.

SELECTION PRACTICED ON COARSEWOOL, CROSSBRED WEANLING LAMBS

Year and Breeding Group No.	Sex	Weaning Weight (lbs.)	Staple Length (cms.)	Fiber Diameter (microns)	Face Covering (score)	Body Type (score)	Condition (score)	Color (score)	Outer- coat Score	Percent Saved	
1953 Group 8	Heritability										
		21%	6%	30%	46%*	4%	11%				
	Rams	Selection Differential	6.59	-.04	2.04	-.09	.39	.24	.43	.15	19.05
		Relative Emphasis	.66	-.04	.71	-.19	.75	.37	.49	.16	
		Expected Genetic Gain	1.384	-.002	.612	-.041	.016	.026	-	-	
	Ewes	Selection Differential	3.17	-.28	.02	.14	.21	.19	-.01	.26	57.14
		Relative Emphasis	.33	-.35	.01	.34	.36	.32	-.01	.26	
		Expected Genetic Gain	.666	-.017	.006	.064	.008	.021	-	-	
	Rams and Ewes	Expected Genetic Gain per Generation	1.025	-.010	.309	.012	.012	.024	-	-	
		Rams	Selection Differential	3.88	.06	.27	.14	.55	.84	.10	.16
Relative Emphasis			.47	.11	.14	.22	.86	1.24	.12	.18	
Expected Genetic Gain	.815		.004	.081	.064	.022	.092	-	-		
Ewes	Selection Differential	2.51	-.06	.62	.08	.22	.29	.49	.17	50.00	
	Relative Emphasis	.23	-.09	.32	.12	.33	.44	.36	.23		
	Expected Genetic Gain	.527	-.004	.186	.037	.009	.032	-	-		
Rams and Ewes											
Expected Genetic Gain per Generation		.671	.000	.134	.050	.016	.062	-	-		

Year	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	

SELECTION PRACTICED ON COARSEWOOL, CROSSBRED WEANLING LAMBS, CONT.

Year and
Breeding
Group No., Sex

Weaning
Weight
(lbs.)

Staple
Length
(cms.)

Fiber
Diameter
(microns)

Face
Covering
(score)

Body
Type
(score)

Condition
(score)

Color
(score)

Outer-
coat
Score

Percent
Saved

1953, cont.

Group
10

Rams

Selection Differential
Relative Emphasis
Expected Genetic Gain

6.59
.64
1.384

.18
.22
.011

1.02
.37
.306

-.07
-.20
-.032

.34
.64
.014

.36
.68
.040

.15
.33
-

.35
.51
-

30.77

Ewes

Selection Differential
Relative Emphasis
Expected Genetic Gain

.80
.14
.168

-.14
-.17
-.008

.48
.15
.144

-.03
-.06
-.014

.11
.29
.004

.05
.11
.006

.05
.09
-

.27
.33
-

77.27

Rams and Ewes

Expected Genetic Gain
per Generation

.776
.002
.225

-.023

.009

.023

-

-

11

Rams

Selection Differential
Relative Emphasis
Expected Genetic Gain

1.00
.14
.210

-.31
-.30
-.019

-.04
.00
-.012

.39
.59
.179

.15
.56
.006

.10
.22
.011

.17
.22
-

.24
.44
-

33.33

Ewes

Selection Differential
Relative Emphasis
Expected Genetic Gain

.90
.15
.189

.11
.11
.007

.78
.31
.234

-.08
-.20
-.037

.10
.25
.004

.20
.42
.022

.13
.14
-

.40
.43
-

66.67

Rams and Ewes

Expected Genetic Gain
per Generation

.200
-.006
.111

.071

.005

.016

-

-

SELECTION PRACTICED ON COARSEWOOL, CROSSED WEANLING LAMBS, CONT.

Year and Breeding Group No.	Sex	Weaning Weight (lbs.)	Staple Length (cms.)	Fiber Diameter (microns)	Face Covering (score)	Body Type (score)	Condition (score)	Color (score)	Outer- coat Score	Percent Saved		
1953, cont.												
Group 16	Rams	Selection Differential	6.01	.06	-.53	.21	.34	.30	.20	.51	19.23	
		Relative Emphasis	.72	.09	-.24	.48	.74	.54	.41	.61		
		Expected Genetic Gain	1.262	.004	-.159	.097	.014	.033	-	-		
	Ewes	Selection Differential	3.14	-.07	-.02	.04	.23	.27	.07	.19	52.38	
		Relative Emphasis	.41	-.10	-.01	.09	.46	.47	.13	.26		
		Expected Genetic Gain	.659	-.004	-.006	.018	.011	.030	-	-		
	Rams and Ewes	Expected Genetic Gain										
		per Generation	.960	.000	-.082	.058	.012	.032	-	-		
	1953 Totals	Rams	Selection Differential	5.25	.03	.61	.11	.36	.38	.20	.38	23.13
			Relative Emphasis	.58	.04	.24	.22	.71	.66	.30	.46	
			Expected Genetic Gain	1.102	.002	.183	.051	.014	.042	-	-	
Ewes		Selection Differential	2.32	-.09	.35	.04	.20	.19	.12	.24	59.32	
		Relative Emphasis	.29	-.12	.13	.08	.36	.35	.15	.29		
		Expected Genetic Gain	.487	-.005	.105	.018	.008	.021	-	-		
Rams and Ewes		Expected Genetic Gain										
		per Generation	.794	-.002	.144	.034	.011	.032	-	-		

* Heritability estimate for face covering score as obtained for range Targhee and Columbia lambs at the U. S. Sheep Experiment Station, Dubois, Idaho.

SELECTION PRACTICED ON COARSEWOOL, CROSSBRED WEANLING LAMBS

Year and Breeding Group No.	Sex	Weaning Weight (lbs.)	Staple Length (cms.)	Fiber Diameter (microns)	Face Covering (score)	Body Type (score)	Condition (score)	Color (score)	Outer- coat Score	Percent Saved
1954 Group 8	Rams	Heritability								
		21%	6%	30%	46%*	4%	11%			
		Selection Differential								
		7.68	-.09	-.86	.37	-.11	.13	.25	.38	22.22
		Relative Emphasis	.87	-.11	-.49	.81	-.30	.32	.34	
	Ewes	Expected Genetic Gain								
		1.613	-.005	-.258	.170	-.004	.014	-	-	
		Selection Differential								
		4.53	-.51	-.29	.01	.16	.23	-.01	.54	38.89
		Relative Emphasis	.64	-.32	-.13	.05	.41	-.01	1.15	
9	Rams	Expected Genetic Gain								
		1.282	-.018	-.172	.088	.001	.020	-	-	
		Selection Differential								
		1.89	.35	-.31	-.27	.35	.30	.21	.19	30.77
		Relative Emphasis	.24	.44	-.15	-.61	.73	.32	.16	
	Ewes	Expected Genetic Gain								
		.397	.021	-.093	-.124	.014	.033	-	-	
		Selection Differential								
		5.98	.26	.69	.00	.45	.35	.54	.36	42.86
		Relative Emphasis	.57	.32	.29	.00	.68	.43	.38	
Rams and Ewes	Expected Genetic Gain per Generation	1.256	.016	.207	.00	.018	.038	-	-	
		Expected Genetic Gain per Generation	.826	.018	.057	-.062	.016	.036		

SELECTION PRACTICED ON COARSEWOOL, CROSSBRED WEANLING LAMBS, CONT.

Year and Breeding Group No.	Sex	Weaning Weight (lbs.)	Staple Length (cms.)	Fiber Diameter (microns)	Face Covering (score)	Body Type (score)	Condition (score)	Color (score)	Outer- coat Score	Percent Saved	
1954, cont.											
Group 10	Rams	Selection Differential	10.49	.25	1.83	-.10	.40	.48	-.14	.99	22.22
		Relative Emphasis	.96	.29	.80	-.20	.74	1.00	-.18	1.14	
		Expected Genetic Gain	2.203	.015	.549	-.046	.016	.053			
Ewes		Selection Differential	5.21	.27	.16	.13	.14	.18	.47	-.16	47.06
		Relative Emphasis	.44	.25	.08	.39	.19	.24	.54	-.15	
		Expected Genetic Gain	1.094	.016	.048	.060	.006	.020	-	-	
Rams and Ewes		Expected Genetic Gain									
		per Generation	1.648	.016	.298	.007	.011	.036	-	-	
11	Rams	Selection Differential	6.06	-.15	-.27	-.14	.27	.22	-.25	.46	41.67
		Relative Emphasis	.57	-.22	-.14	-.27	.53	.66	-.18	.50	
		Expected Genetic Gain	1.273	-.009	-.081	-.064	.011	.024	-	-	
Ewes	Selection Differential	-	-	-	-	-	-	-	-	-	0

1911

1912

1913

1914

1915

1916

1917

1918

1919

1920

1921

1922

1923

1924

SELECTION PRACTICED ON COARSEWOL, CROSSBRED WEANLING LAMBS, CONT.

Year and Breeding Group No.	Sex	Weaning Weight (lbs.)	Staple Length (cms.)	Fiber Diameter (microns)	Face Covering (score)	Body Type (score)	Condition (score)	Color (score)	Outer- coat Score	Percent Saved	
1954, cont.											
Group 16	Rams	Selection Differential	8.84	-.11	.31	.12	.39	.34	.05	.59	23.08
		Relative Emphasis	.84	-.14	.17	.28	.70	.63	.05	.60	
		Expected Genetic Gain	1.856	-.007	.093	.055	.016	.037	-	-	
	Ewes	Selection Differential	2.92	-.02	.16	.03	.17	.25	.02	.28	55.07
		Relative Emphasis	.33	-.03	.09	.07	.38	.48	.02	.28	
		Expected Genetic Gain	.613	-.001	.048	.014	.007	.028	-	-	
	Rams and Ewes	Expected Genetic Gain per Generation	1.234	.004	.070	.034	.012	.032	-	-	
	1954										
	Totals	Rams	Selection Differential	7.95	-.03	.17	.04	.32	.32	.02	.59
		Relative Emphasis	.77	-.04	.09	.08	.61	.63	.02	.61	
		Expected Genetic Gain	1.670	-.002	.051	.018	.013	.035	-	-	
	Ewes	Selection Differential	3.68	-.02	.12	.03	.20	.26	.13	.27	47.97
		Relative Emphasis	.40	-.02	.06	.08	.39	.48	.13	.27	
		Expected Genetic Gain	.773	-.001	.036	.014	.008	.029	-	-	
	Rams and Ewes	Expected Genetic Gain per Generation	1.222	-.002	.044	.016	.010	.032	-	-	

* Heritability estimate for face covering score as obtained for range Targhee and Columbia lambs at the U. S. Sheep Experiment Station, Dubois, Idaho.

BODY WEIGHTS AND SCORES OF COARSEWOOL, CROSSBRED YEARLING RAMS

The following table shows the body weights and scores of the yearling rams in research project 2. The rams were lighter in body weight and had poorer body type scores in 1953 and 1954 than in prior years. Condition score was poorer than most previous years in 1953, but was better than average in 1954. Face covering score was better in 1953 than any other year, and above the average in 1954. Outercoat score averaged approximately the same in 1953 and 1954, and was considerably better than all years except 1952.

Year and Breeding Group No.	No. of Rams	Body Weight (lbs.)	Type Score	Condition (score)	Face Covering (score)	Color Score	Outer- coat Score
1949	98	126.0	2.21	2.20	2.63	1.38	2.56
1950	102	118.0	2.39	2.57	2.75	1.37	2.40
1951	66	109.7	2.32	2.70	2.96	1.36	2.81
1952	8	112.4	2.56	2.60	2.10	1.71	1.58
1949-52 Totals & Averages	274	118.7	2.31	2.47	2.74	1.38	2.53
1953 Group							
8	9	109.9	2.58	2.74	2.15	1.59	1.50
9	7	109.0	2.83	2.68	1.48	1.43	1.38
10	12	99.6	2.94	2.71	1.72	1.11	2.15
11	7	109.6	2.62	2.83	1.55	1.19	1.64
16	6	116.2	2.52	2.52	1.56	1.72	1.61
17	3	107.3	2.48	2.41	1.37	2.00	1.45
Totals & Averages	44	107.6	2.69	2.68	1.70	1.42	1.69
1954 Group							
8	4	102.0	2.89	2.56	2.96	1.00	1.75
9	3	114.7	2.82	2.37	1.95	1.00	2.67
10	8	103.6	2.44	2.36	2.38	1.62	1.33
11	4	98.0	2.78	2.30	2.00	1.00	1.75
16	10	105.3	2.67	2.37	2.08	1.10	1.58
Totals & Averages	29	104.3	2.63	2.38	2.26	1.21	1.67

FLEECE CHARACTERISTICS OF COARSEWOOL, CROSSBRED YEARLING RAMS

The saved ram lambs usually spend their first winter in the corrals at Laboratory headquarters on a ration of alfalfa hay. Hence at yearling age, the rams of different years have all been on a more or less comparable plane of nutrition. Such a situation is not true of the yearling ewes that are wintered on the range. Thus the reduction in fiber diameter, staple length, and percent medullated fibers in 1953 and 1954 from prior years can be attributed largely to selection of rams with uniform fleeces that are free of breechiness, outercoat, and medullated fibers. Whereas the fleeces have averaged 3/8 or half blood in 1953 and 1954, by means of the cross sectioning technique, a visual grade based largely on fleece character would place practically all of these fleeces in the quarter blood or 3/8 grade.

Clean fleece weight has remained at a constant average for the past three years, and has been better than 1951 but lower than 1949 and 1950. The reduction in clean fleece weight from the higher levels of 1949 and 1950 is no doubt due to selection as described above. As the average clean fleece weights have remained constant, the smaller grease fleece weights in 1953 and 1954 undoubtedly reflect cleaner fleeces.

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FLEECE CHARACTERISTICS OF COARSEWOOL, CROSSBRED YEARLING RAMS

Year and Breeding Group No.	No. of Rams	Fleece Weights		Fiber Diameter (microns)	Grade*	Staple Length (cms.)	Other Med. Fibers (percent)
		Grease (lbs.)	Clean (lbs.)				
1949	101	9.40	6.46	30.8	50s	12.4	0.60
1950	102	9.28	5.61	29.7	54s	13.4	.20
1951	66	8.67	3.93	30.4	50s	11.8	.29
1952	8	8.28	4.54	30.8	50s	11.5	.00
1949-52 Totals & Averages	277	9.15	5.49	30.3	50s	12.6	0.36
1953 Group							
8	9	7.18	4.49	29.3	54s	11.9	.00
9	7	6.86	4.49	26.3	58s	11.2	.00
10	12	5.96	4.26	28.8	54s	11.4	.00
11	7	6.79	4.93	29.0	54s	11.4	.00
16	6	8.12	5.04	30.6	50s	10.3	.53
17	3	5.87	4.15	32.8	48s	10.9	.00
Totals & Averages	44	6.77	4.54	29.0	54s	11.3	.07
1954 Group							
8	4	6.46	4.66	25.3	60s	10.6	.00
9	3	7.30	5.70	26.7	58s	11.1	.00
10	8	5.75	4.28	24.2	60s	9.8	.00
11	4	6.26	4.44	26.4	58s	11.0	.00
16	10	6.14	4.43	24.5	60s	9.6	.00
Totals & Averages	29	6.21	4.56	25.0	60s	10.1	.00

* Grade for all years converted to latest ASTM Standards, adopted June, 1953.

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BODY WEIGHTS AND SCORES OF COARSEWOOL, CROSSBRED YEARLING EWES

The body weights and scores of the yearling ewes in research project 2 are summarized in the following table. Beginning in 1954, body weights, and type and condition scores are adjusted to a constant age of 400 days and for age of dam and type of birth and rearing. Prior years data have not been adjusted for environmental effects. June body weights were average in 1954, but below average in 1953. Type and condition scores show little difference from prior years, but are very slightly below the average. Face covering scores are better in 1953 and 1954 than in any previous year except 1952, and are above the average, while color and outercoat scores approximate the average in 1953 and are slightly above average in 1954.

Year and Breeding Group No.	No. of Ewes	Body Weight (lbs.)	Type Score	Condition Score	Face Covering Score	Color Score	Outer- coat Score
1949	260	85.4	2.22	2.27	2.34	1.38	2.74
1950	219	83.1	2.36	2.59	2.80	1.41	2.78
1951	189	53.5	2.70	2.94	2.90	1.40	2.89
1952	34	86.4	2.45	2.39	1.97	2.67	2.81
1949-52 Totals & Averages	702	76.1	2.40	2.56	2.62	1.46	2.80
1953 Group							
8	30	74.1	2.61	2.72	2.30	1.47	2.85
9	19	73.2	2.57	2.77	1.73	1.67	2.46
10	40	73.2	2.65	2.80	1.90	1.38	2.75
11	20	71.0	2.74	2.93	2.17	1.32	2.85
16	17	70.1	2.80	2.86	2.28	1.57	2.64
17	4	74.8	2.81	2.89	1.54	1.50	2.82
Totals & Averages	130	72.7	2.67	2.81	2.05	1.46	2.71
1954 Group							
8	11	75.9	2.78	2.69	2.70	1.73	2.74
9	9	77.5	2.88	2.63	2.17	1.11	1.78
10	16	78.8	2.77	2.60	1.74	1.20	2.22
11	10	75.2	2.90	2.67	1.85	1.20	1.99
16	21	75.4	2.71	2.61	2.08	1.15	1.72
Totals & Averages	67	76.5	2.79	2.63	2.09	1.26	2.06

FLEECE CHARACTERISTICS OF COARSEWOOL, CROSSBRED YEARLING EWES

As only one ewe fleece possessed kemp fibers (1.49 percent) in 1953 and none in 1954, this trait is no longer included in the table which follows. Clean fleece weights are adjusted to a constant age of 365 days and for 12 percent moisture content for all years, and in addition, are also adjusted for age of dam and type of birth and rearing in 1953 and 1954. Grease fleece weights and staple lengths are adjusted to 365 days of age for all years and for age of dam and type of birth and rearing in 1953 and 1954. Clean fleece weights averaged approximately the same in 1953 and 1954 as in 1952, but were lower than in 1949 and 1950. Grease fleece weights were smaller in 1953 and 1954 than in any of the other years except 1951.

Fiber diameter varies considerably between years and is influenced to a rather large degree by the plane of nutrition of the ewes during the winter months preceding sampling in mid-April of each year. Staple length has shown a trend toward shorter lengths in recent years and is probably due in part to selection of ewes with uniform fleeces that are free of breechiness, outercoat, kemp, and medullated fibers. Percent medullated fibers has shown a decline in all years except 1954, when a small increase was noted.

FLEECE CHARACTERISTICS OF COARSEWOOL, CROSSBRED YEARLING EWES

Year and Breeding Group No.	No. of Ewes	Fleece Weights		Fiber Traits at Side			
		Gross (lbs.)	Clean (lbs.)	Fiber Diameter (microns)	Grade*	Staple Length (cms.)	Other Med. Fibers (percent)
1949	260	7.06	4.66	25.1	60s	10.8	0.9
1950	219	8.14	4.09	25.0	60s	12.0	.4
1951	189	4.65	2.32	20.6	70s	11.2	.3
1952	34	6.87	3.37	29.8	54s	8.9	.1
1949-52 Totals & Averages	702	6.74	3.79	24.1	60s	11.2	.5
1953 Group							
8	30	5.91	3.52	24.1	60s	9.6	.0
9	19	5.52	3.31	22.8	62s	10.3	.2
10	40	5.09	3.31	24.5	60s	9.7	.0
11	20	5.67	3.68	25.7	58s	9.8	.0
16	17	4.73	2.84	23.8	62s	9.1	.2
17	4	4.66	2.88	25.2	60s	10.0	.0
Totals & Averages	130	5.37	3.34	24.3	60s	9.7	.1
1954 Group							
8	11	5.81	3.84	25.7	58s	9.8	.7
9	9	5.59	3.28	25.1	60s	9.3	.0
10	16	4.74	3.24	26.3	58s	9.5	.9
11	10	5.79	3.54	24.1	60s	9.1	.0
16	21	5.04	3.15	26.2	58s	8.8	.0
Totals & Averages	67	5.30	3.37	25.7	58s	9.3	.3

* Grade for all years converted to latest ASTM Standards, adopted June 1953.

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RESEARCH PROJECT 3

IMPROVEMENT OF NAVAJO SHEEP BY CROSSBREEDING AND SELECTION FOR RANGE PRODUCTION OF WOOL AND LAMBS SUITED TO MARKET REQUIREMENTS.

The objective of this project is to develop a strain of sheep that will be well adapted to southwestern range conditions, with inheritance for efficient production of high quality feeder lambs and combing length wool between 60s and 62s grade. This project was initiated in 1948. The finest fleeced crossbred ewes with inheritance of 1/2 Navajo, 1/4 Romney and 1/4 Corriedale were mated to rams of Targhee, New Zealand Merino and Debouillet breeds. A few Navajo ewes were mated to a Rambouillet ram to test the relative performance of these crosses under the same environmental conditions. Since these initial matings were made in 1948-49, only Targhee rams have been used with the ewes going into this research project.

The use of Targhee rams has been continued in group 12. The rams and ewes in group 13 are the progeny of previous Targhee matings. In addition to the Targhee F₁ ewes in this group, a few ewes sired by the Debouillet and Merino rams used in 1948-49 are included.

CHARACTERISTICS OF FINEWOL CROSSBRED BREEDING RAMS

Numbers of rams used in each breeding group, their body weight at breeding, age at lambing time, and fleece characteristics at yearling age are given in the following table. Group 13 rams are F₁ Targhee crossbred rams, and there were four of them used in 1954, two each in 1953 and 1952, and one each in 1951 and 1950. Other groups are pure-bred Targhee, Merino, Debouillet, and Rambouillet rams which were obtained from the Western Sheep Breeding Laboratory, Dubois, Idaho and from private breeders.

Year and Breeding Group No.	No. of Rams	Age at Lambing Time (years)	Body Wt. at Breeding (lbs.)	Yearling Fleece Weights		Yearling Fiber Traits at Side		
				Grease (lbs.)	Clean (lbs.)	Fiber Dia. (microns)	Grade#	Staple Length (cms.)
1949	4	3.2	-	13.02	6.84	22.2	64s	12.2
1950	5	4.0	189.8	12.69	6.92	22.2	64s	12.2
1951	12	3.0	194.9	10.83	5.10	22.2	64s	8.8
1952	5	4.0	185.0	10.98	4.68	22.0	64s	9.6
1952**	3	2.7	188.0	19.22	6.68	24.6	60s	9.6
1949-52	29	3.3	191.1	12.35	5.74	22.4	64s	10.1
1953								
Group 12	2	5.5	208.0	12.85	6.25	21.0	70s	10.1
Group 13	2	3.0	187.0	9.49	4.90	23.8	62s	9.4
Totals	4	4.2	197.5	11.17	5.58	22.4	64s	9.8
1954								
Group 12	2	4.5	209.5	11.75	5.65	24.6	60s	8.1
Group 13	4	3.0	156.8	9.34	5.13	26.6	58s	9.8
Totals	6	3.5	174.3	10.31	5.30	25.9	58s	9.2

* Grade for all years converted to latest ASTM standards, adopted June, 1953.

** Three of the rams used in 1952 were purchased from private breeders and yearling records were not available. Fleece traits listed are their 2-year-old record.

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CHARACTERISTICS OF FINEWOOL CROSSBRED BREEDING EWES

Average age of the ewes at lambing, body weight at 18 months, and yearling fleece characteristics of the breeding ewes in research project 3 are summarized by years and breeding groups in the following table.

Grease fleece and clean fleece weights exceeded the 1949-1952 average in both 1953 and 1954, with 1953 being the better of the two years and the best on record for both traits. With the increase in fleece weights, there appears to be a slight increase in fineness and decrease in staple length, although fiber diameter measurements are influenced somewhat by winter range feed conditions. The percentage of medullated fibers has been steadily decreasing since 1951. Kemp fibers, which have never exceeded 0.1 percent, were practically non-existent in 1953 and 1954, and are no longer reported. The decrease in body weight is probably due primarily to short range feed in both 1953 and 1954.

Year and Breeding Group No.	No. of Ewes	Age at Lambing Time (years)	Body Wt. at 18 Mos. (lbs.)	Yearling Fleece Weights		Yearling Fiber Traits at Side		
				Grease (lbs.)	Clean (lbs.)	Grade	Staple Length (cms.)	Med. Fibers (percent)
1949	127	5.2	108.8	5.76	3.22	60s	8.2	0.5
1950	156	5.8	107.5	5.48	3.07	60s	8.4	0.6
1951	390	4.9	101.9	6.29	2.94	56s	11.2	2.0
1952	243	4.5	102.7	6.90	3.21	58s	9.9	1.5
1949-52	916	5.0	104.0	6.24	3.07	58s	10.0	1.4
1953								
Group 12	58	5.6	107.4	7.26	4.03	58s	9.8	1.7
Group 13	45	2.9	97.6	6.74	3.04	64s	8.4	.0
Totals	103	4.4	103.1	7.04	3.60	60s	9.2	1.0
1954								
Group 12	40	6.0	105.3	6.91	4.01	60s	10.2	1.8
Group 13	79	2.9	98.6	6.41	3.01	70s	8.4	.0
Totals	119	3.9	100.9	6.58	3.37	64s	9.0	0.6

LAMB PRODUCTION OF FINEWOL CROSSBRED MATINGS

The lamb production of the ewes in research project 3 is summarized in the following table. Lamb production in 1953 was better in all respects than that obtained in 1954. The percentages of lambs weaned of live lambs born and of lambs weaned of ewes bred in 1953 were superior to all other years. For all other traits, the years 1953 and 1954 were neither particularly good nor especially bad.

As in the other research projects, the percent of ewes lambing is based on the number of ewes bred and surviving to lambing. The percent of lambs born of ewes lambing is based on the total lambs born, regardless of whether they were alive or dead, and minus 100 is the percentage of twinning. These two classifications are influenced by the fertility of the ram as well as that of the ewes in each pen. The percent of lambs weaned of live lambs born is a measure of lamb mortality, while the percent of lambs weaned of ewes bred combines the first three values plus any effect of ewe loss after breeding. Average weaning weight has been corrected for age of dam, but for all other traits it should be remembered that the ewes in each group are not all the same age and therefore the figures in this table are not directly comparable.

Year and Breeding Group No.	No. of Ewes Bred	^{1/} Percent of Ewes Lambing	Percent Lambs Born of Ewes Lambing	Percent Lambs Weaned of Live Lambs Born	Percent Lambs Weaned of Ewes Bred	Average Weaning Weight in Pounds	Pounds of Lamb per Ewe Bred
1949	127	92.0	147.8	81.5	107.9	62.1	67.0
1950	156	63.9	144.7	73.3	63.5	45.3	28.8
1951	390	89.8	105.8	34.6	32.1	35.8	11.5 ^{2/}
1952	243	94.2	119.4	90.7	100.4	66.1	66.3
1949-52	916	87.0	120.7	64.8	66.0	55.5	36.7
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1953							
Group 12	58	91.2	126.9	93.9	106.9	59.5	63.6
Group 13	45	90.0	133.3	100.0	109.5	57.4	62.8
Totals	103	90.7	129.5	96.4	108.0	58.6	63.3
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1954							
Group 12	40	85.7	140.0	73.2	75.0	59.1	44.3
Group 13	79	92.0	118.8	88.6	88.6	55.7	49.4
Totals	119	90.0	125.3	83.3	84.0	56.7	47.7

- ^{1/} Percent of ewes lambing of ewes bred and still present at lambing.
^{2/} 29.7 percent of ewes lambing and 52.9 percent of lambs born alive killed by hailstorm, May 30, 1951.

FACE AND BODY SCORES OF FINEWOOL CROSSBRED WEANLING LAMBS

Face covering, body type and condition scores of the weanling lambs in research project 3 for the years 1949 through 1954 are summarized in the following table.

Averages for each trait show little difference between groups within sexes. Ewe lambs are generally better than the ram lambs for all three traits. Face covering scores for 1953 and 1954, for both sexes, were slightly poorer than the 1949-52 average. However, all lambs are sufficiently open-faced that wool blindness does not present a problem, and only rarely is a lamb culled because of too much wool on the face. Body type and condition scores, on the other hand, exceeded the 1949-52 average in all but one instance.

RAM LAMBS					EWE LAMBS			
Year and Breeding Group No.	No. of Lambs	Face Covering (score)	Type (score)	Condition (score)	No. of Lambs	Face Covering (score)	Type (score)	Condition (score)
1949	74	3.10	2.52	2.49	63	3.04	2.57	2.39
1950	47	3.07	3.70	2.94	52	2.91	2.91	3.58
1951	61	2.90	3.25	3.36	64	2.67	3.26	3.20
1952	124	2.64	2.85	3.16	120	2.34	2.31	2.47
1949-52	306	2.87	2.98	2.87	299	2.66	2.67	2.80
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1953								
Group 12	36	3.06	2.47	2.69	26	2.85	2.41	2.58
Group 13	20	2.95	2.60	2.73	26	2.97	2.56	2.71
Totals	56	3.02	2.52	2.71	52	2.91	2.49	2.65
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1954								
Group 12	11	3.09	2.53	2.75	19	2.90	2.55	2.73
Group 13	35	3.02	2.36	2.64	35	3.01	2.72	2.92
Totals	46	3.04	2.40	2.67	54	2.97	2.66	2.86

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FLEECE CHARACTERISTICS OF FINEWOL CROSSBRED WEANLING LAMBS

The following table summarizes the fleece characteristics of the weanling lambs in research project 3. Only small differences occur between breeding groups within years for most of the traits, but differences between years are sometimes rather sizeable. This is particularly true of fiber diameter which is affected to a greater degree by yearly environmental differences. Although the averages of both groups in 1953 and 1954 showed less outercoat fibers than in any previous year, the lambs are still not as uniform with respect to fleece type as desired. Further selection against outercoat and medullated fibers will no doubt result in finer fleeces and a somewhat shorter staple length.

Year and Breeding Group No.	No. of Lambs	Fiber Diameter	Grade*	Staple Length (cms.)	Kemp (percent)	Other Med. Fibers (percent)	Outer- coat (score)
1949	137	24.2	60s	3.40	.10	.50	2.26
1950	99	23.0	62s	3.00	.10	.90	2.10
1951	125	21.7	64s	3.50	.14	1.39	2.14
1952	244	25.2	60s	3.22	.14	.88	1.78
1949-52	605	23.9	62s	3.28	.12	.90	2.02
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1953							
Group 12	62	26.8	58s	3.09	.12	.93	1.13
Group 13	46	26.7	58s	3.05	.00	.72	1.28
Totals	108	26.8	58s	3.07	.07	.84	1.19
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1954							
Group 12	30	24.5	60s	3.12	.29	.27	1.43
Group 13	70	23.2	62s	3.04	.23	.76	1.39
Totals	100	23.6	62s	3.06	.25	.61	1.40

* Grade for all years converted to latest ASTM standards, adopted June, 1953.

THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. From the first settlers to the present day, the nation has evolved through various stages of development. The early years were marked by exploration and settlement, followed by a period of rapid expansion and industrialization. The American Revolution was a pivotal moment in the nation's history, leading to the establishment of a new government and the declaration of independence. The 19th century was a time of great achievement, with the nation expanding its territory and becoming a world power. The 20th century has been a period of significant change, with the United States playing a leading role in the world. The future of the nation is uncertain, but its history is a testament to the resilience and strength of the American people.

Year	Event	Location	Significance
1492	Christopher Columbus discovers America	San Salvador, Bahamas	First European contact with the Americas
1607	First permanent English settlement established	Jamestown, Virginia	Beginning of English colonization
1776	Declaration of Independence	Philadelphia, Pennsylvania	United States becomes an independent nation
1862	Emancipation Proclamation issued	Washington, D.C.	Slavery abolished in the United States
1945	World War II ends	Yokohama, Japan	United States emerges as a superpower

Year	Event	Location	Significance
1789	Constitution of the United States signed	Philadelphia, Pennsylvania	Establishes the framework for the federal government
1803	Louisiana Purchase	St. Louis, Missouri	Doubles the size of the United States
1898	Spanish-American War ends	Santiago, Cuba	United States becomes a world power
1914	World War I begins	Europe	United States enters the war
1941	Pearl Harbor attack	Pearl Harbor, Hawaii	United States enters World War II

The history of the United States is a story of growth and change. From the first settlers to the present day, the nation has evolved through various stages of development. The early years were marked by exploration and settlement, followed by a period of rapid expansion and industrialization. The American Revolution was a pivotal moment in the nation's history, leading to the establishment of a new government and the declaration of independence. The 19th century was a time of great achievement, with the nation expanding its territory and becoming a world power. The 20th century has been a period of significant change, with the United States playing a leading role in the world. The future of the nation is uncertain, but its history is a testament to the resilience and strength of the American people.

SELECTION PRACTICED ON FINEWOOL CROSSBRED WEANLING LAMBS

The selection differentials, relative emphasis placed on each trait, and the expected genetic gain per generation for the weanling lambs in research project 3 are presented in the following table. Computational procedures used are described in the preceding section (Page 39). As previously noted, the heritability estimate for face covering score is that obtained at the U. S. Sheep Experiment Station at Dubois, Idaho for range Targhee and Columbia lambs. For that reason, the estimate of expected genetic gain is only accurate to the extent that the Dubois heritability estimate pertains to the lambs at Fort Wingate.

In 1953, 10 ram lambs and 30 ewe lambs were saved from totals of 56 and 52 weaned, respectively. In 1954, 14 ram lambs and 27 ewe lambs were saved from totals of 46 and 53 weaned, respectively.

In general, greatest emphasis was placed on weaning weight, body type, and condition scores for the ram lambs, and on body type, and condition and outercoat scores for the ewe lambs. In 1953, considerable emphasis was placed on fiber diameter for both sexes in breeding group 13.

Contrary to some prior years, negative selection differentials for fiber diameter indicate selection of lambs with finer fleeces. This is not undesirable for this project. Negative selection differentials for staple length indicate that the lambs saved had shorter staple, on the average, than the average of all lambs. This consequence probably results in part from the positive selection against outercoat and medullated fibers. In a few instances, selection favored lambs with poorer face and color scores.

It is a well-known fact that the American Medical Association has been the leading organization in the world for the advancement of the medical profession. It has been the center of the medical world for many years, and it has been the source of many of the most important medical advances of the last century. The Association has been the leading organization in the world for the advancement of the medical profession, and it has been the source of many of the most important medical advances of the last century.

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SELECTION PRACTICED ON FINEWOL CROSSBRED WEANLING LAMBS

Year & Group No.	Sex	Heritability	Weaning Weight (lbs.)	Staple Length (cms.)	Fiber Diameter (microns)	Face Covering (score)	Body Type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent Saved
1953		21%		6%	30%	46%	4%	11%			
	Rams	Selection Differential Relative Emphasis Expected Genetic Gain	7.97 .88 1.674	-.07 -.16 -.004	.61 .30 .183	-.05 -.15 -.023	.54 1.10 .022	.45 .83 .050	.06 .26 -	.05 .29 -	16.67
	Ewes	Selection Differential Relative Emphasis Expected Genetic Gain	1.39 .21 .292	-.04 -.10 -.002	-.03 -.02 -.009	.03 .07 .014	.14 .33 .006	.12 .29 .013	.12 .28 -	.11 .35 -	65.38
	Rams & Ewes	Expected Genetic Gain per Generation	.983	.003	.087	-.004	.014	.032	-	-	
	13 Rams	Selection Differential Relative Emphasis Expected Genetic Gain	10.39 1.20 2.182	.19 .36 .011	-.20 -1.11 -.060	.28 .60 .129	.33 .72 .013	.30 .56 .033	.30 .45 -	.04 .31 -	20.00
Rams & Ewes	Ewes	Selection Differential Relative Emphasis Expected Genetic Gain	1.39 .19 .292	-.04 -.08 -.002	-.11 -.46 -.033	-.11 -.29 -.051	.23 .39 .009	.20 .31 .022	-.03 -.09 -	.15 .28 -	50.00
	Rams & Ewes	Expected Genetic Gain per Generation	1.237	.004	-.046	.039	.011	.028	-	-	
	TOTALS										
	Rams	Selection Differential Relative Emphasis Expected Genetic Gain	8.99 1.02 1.888	.03 .06 .002	.30 .15 .090	.09 .23 .041	.42 .88 .017	.39 .72 .043	.14 .32 -	.05 .31 -	17.86
	Ewes	Selection Differential Relative Emphasis Expected Genetic Gain	1.68 .23 .353	-.04 -.09 -.002	-.01 .00 -.003	-.02 -.05 -.009	.19 .37 .008	.17 .31 .019	.05 .13 -	.15 .33 -	57.69
Rams & Ewes	Expected Genetic Gain per Generation	1.120	.000	.044	.016	.012	.031	-	-		

SELECTION PRACTICED ON FINEWOL CROSSBRED WEANLING LAMBS, CONT.

Year & Group No.	Sex		Weaning Weight (lbs.)	Staple Length (cms.)	Fiber Diameter (microns)	Face Covering (score)	Body Type (score)	Condition (score)	Color (score)	Outer- coat (score)	Percent Saved
1954		Heritability	21%	6%	30%	46%	4%	11%			
12	Rams	Selection Differential Relative Emphasis Expected Genetic Gain	6.66 .85 1.399	-.05 -.13 -.003	.84 .41 .252	.09 .27 .041	.38 .70 .015	.42 .85 .046	-.15 -.37 -	.18 .58 -	27.27
	Ewes	Selection Differential Relative Emphasis Expected Genetic Gain	5.49 .51 1.153	-.13 -.29 -.008	-.39 -.29 -.117	.02 .10 .009	.43 .65 .017	.36 .53 .040	.05 .22 -	.46 .50 -	57.89
	Rams & Ewes	Expected Genetic Gain per Generation	1.276	-.005	.067	.025	.016	.043	-	-	
13	Rams	Selection Differential Relative Emphasis Expected Genetic Gain	4.88 .57 1.025	-.09 -.24 -.005	.26 .15 .078	-.01 -.03 -.005	.28 .58 .011	.40 .76 .044	.10 .14 -	.27 .47 -	31.43
	Ewes	Selection Differential Relative Emphasis Expected Genetic Gain	2.61 .31 .548	.02 .05 .001	-.11 -.05 -.033	.03 .07 .014	.25 .44 .010	.34 .52 .037	.12 .36 -	.33 .64 -	47.06
	Rams & Ewes	Expected Genetic Gain per Generation	.786	-.002	.022	.004	.010	.040	-	-	
TOTALS											
	Rams	Selection Differential Relative Emphasis Expected Genetic Gain	5.18 .61 1.088	-.08 -.21 -.005	.37 .21 .111	.02 .05 .009	.31 .61 .012	.41 .80 .045	.04 .06 -	.26 .50 -	30.43
	Ewes	Selection Differential Relative Emphasis Expected Genetic Gain	4.05 .42 .850	-.04 -.09 -.002	-.15 -.07 -.045	.03 .09 .014	.33 .54 .013	.35 .52 .038	.09 .30 -	.37 .54 -	50.94
	Rams & Ewes	Expected Genetic Gain per Generation	.969	-.004	.033	.012	.012	.042	-	-	

BODY WEIGHTS AND SCORES OF FINEWOOL CROSSBRED YEARLING RAMS

The following table presents a summarization of body weights and scores of finewool, crossbred yearling rams. The 1954 group was better than the 1953 group in all traits except face covering. Here, the 1953 rams were better, but the 1954 group still show considerable improvement over the 1950-52 average for face score. Both later groups were, in general, superior to the groups of 1950-52 rams. Body weights were down somewhat and this is no doubt a reflection of the dry range conditions.

Year and Breeding Group No.	No. of Rams	Body Weight (lbs.)	Type (score)	Condition (score)	Face Covering (score)	Color (score)	Outer- coat (score)
1950	24	113.3	2.43	2.13	2.99	1.13	1.35
1951	13	113.7	1.84	2.07	3.10	1.38	2.05
1952	2	101.0	3.05	3.44	1.94	1.00	2.00
1950-52	39	112.8	2.26	2.18	2.97	1.21	1.62
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1953							
Group 12	6	108.2	2.48	2.30	1.67	1.33	1.03
Group 13	3	108.7	2.78	2.22	2.06	1.44	1.33
Group T-14	3	112.3	2.48	2.33	2.33	1.00	1.45
Group T-15	3	116.0	2.33	1.93	1.56	1.00	1.00
Totals	15	110.7	2.51	2.21	1.86	1.22	1.17
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1954							
Group 12	6	111.7	2.24	2.00	2.36	1.17	1.22
Group 13	4	113.5	2.56	4.14	2.84	1.00	1.00
Totals	10	112.4	2.37	2.06	2.55	1.10	1.13

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FLEECE CHARACTERISTICS OF FINEWOOL CROSSBRED YEARLING RAMS

Fleece weights, fiber diameter, grade and staple length are averaged and presented in the following table for finewool, crossbred yearling rams. Grade has fluctuated from 58's to 64's from 1950 through 1954. Selection is against coarse fibers in this group and the fluctuation can likely be attributed to yearly differences in feed supply and weather conditions.

Staple length has declined in both 1953 and 1954, due largely to selection for finer grading wool and elimination of hairy, kempy fleeces.

Grease fleece weights have declined both years, but clean wool production, or "yield", has increased. The 1953 groups averaged 1.07 pounds less grease wool, yet had 3.75 percent higher yield. The 1954 groups averaged .77 pounds less grease weight than the 1953 groups, yet the yield was 12.81 percent higher.

Year and Breeding Group No.	No. of Rams	Fleece Weights		Fiber Traits at Side		
		Grease (lbs.)	Clean (lbs.)	Fiber Diameter (microns)	Grade*	Staple Length (cms.)
1950	24	8.96	4.89	24.6	60s	11.5
1951	13	9.84	3.36	23.9	62s	9.5
1952	2	7.71	3.86	26.6	58s	9.2
1950-52	39	9.19	4.33	24.5	60s	10.7
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1953						
Group 12	6	7.42	3.79	25.1	60s	9.6
Group 13	3	8.71	4.21	24.9	60s	10.4
Group T-14	3	8.16	4.05	26.1	58s	9.7
Group T-15	3	8.86	4.82	28.9	54s	9.4
Totals	15	8.12	4.13	26.0	58s	9.7
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1954						
Group 12	6	7.64	4.91	22.0	64s	9.1
Group 13	4	6.91	4.33	20.7	70s	7.8
Totals	10	7.35	4.68	21.5	64s	8.6

* Grade for all years converted to latest ASTM standards, adopted June 1953.

1. The first part of the report is a summary of the work done during the year.

2. The second part is a detailed account of the experiments carried out.

3. The third part is a discussion of the results obtained.

4. The fourth part is a conclusion.

5. The fifth part is a list of references.

6. The sixth part is a list of symbols.

7. The seventh part is a list of abbreviations.

8. The eighth part is a list of figures.

9. The ninth part is a list of tables.

10. The tenth part is a list of appendices.

11. The eleventh part is a list of footnotes.

12. The twelfth part is a list of references.

13. The thirteenth part is a list of symbols.

14. The fourteenth part is a list of abbreviations.

15. The fifteenth part is a list of figures.

16. The sixteenth part is a list of tables.

17. The seventeenth part is a list of appendices.

18. The eighteenth part is a list of footnotes.

19. The nineteenth part is a list of references.

20. The twentieth part is a list of symbols.

BODY WEIGHTS AND SCORES OF FINEWOL, CROSSBRED YEARLING EWES

The body weights and scores of finewool, crossbred yearling ewes are presented in the following table. In comparing the latter two years of 1953 and 1954, it is obvious that the 1954 ewes are superior and gains have been made for each trait. Both latter years are superior to the 1950-52 averages in all traits except type and condition. Here, the 1953 ewes fall below the 1950-52 average. A very definite gain has been made in face, color and outercoat scores. The most important trait, body weight, averages from 2.5 to 6.0 pounds heavier than the 1950-52 average.

Year and Breeding Group No.	No. of Ewes	Body Weight (lbs.)	Type (score)	Condition (score)	Face Covering (score)	Color (score)	Outer- coat (score)
1950	49	81.8	2.22	2.13	2.76	1.14	1.68
1951	35	55.4	2.47	2.49	3.03	1.20	2.01
1952	21	87.0	2.49	2.29	2.09	1.90	1.39
1950-52	105	74.0	2.36	2.28	2.72	1.31	1.73
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1953							
Group 12	28	77.8	2.37	2.41	1.98	1.26	1.35
Group 13	13	73.1	2.71	2.62	2.10	1.13	1.51
Group T-14	6	79.2	2.54	2.31	2.22	1.11	1.33
Group T-15	5	75.0	2.47	2.40	2.13	1.00	1.20
Totals	52	76.5	2.48	2.45	2.05	1.19	1.38
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1954							
Group 12	17	80.7	2.13	1.93	2.14	1.00	1.17
Group 13	10	78.7	2.27	1.97	2.07	1.20	1.22
Totals	27	80.0	2.18	1.94	2.11	1.07	1.19

FLEECE CHARACTERISTICS OF FINEWOOL, CROSSBRED YEARLING EWES

In studying the fleece characteristics of finewool, crossbred yearling ewes of 1953 and 1954, several factors are outstanding. Grease fleece weights of 1953 and 1954 are both lower than the 1950-52 average for this trait. In spite of the lowered grease weight, the percent of yield, or clean wool production, is increased. The 1953 yearling ewes averaged .82 pounds less grease wool than the 1950-52 average, yet produced a yield of 6.27 percent more clean wool. The 1954 ewes had .09 pounds more grease wool than the 1953 ewes, and produced 0.59 percent higher yield. This is also well over the 1950-52 average by 6.86 percent more clean wool from .73 less grease wool. This increased production has been gained while still maintaining a grade of 70's and holding staple length approximately the same. Staple length was down 0.9 centimeters in 1954.

Year and Breeding Group No.	No. of Ewes	Fleece Weights		Fiber Traits at Side		
		Grease (lbs.)	Clean (lbs.)	Fiber Diameter (microns)	Grade*	Staple Length (cms.)
1950	49	8.70	3.64	20.9	70s	9.1
1951	35	5.00	1.90	17.2	80s	9.2
1952	21	6.52	2.89	24.5	60s	6.3
1950-52	105	7.03	2.91	20.4	70s	8.6
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1953						
Group 12	28	6.24	2.99	20.9	70s	8.4
Group 13	13	6.01	2.79	19.6	70s	8.9
Group T-14	6	6.32	2.94	20.5	70s	8.4
Group T-15	5	6.43	3.37	20.4	70s	8.6
Totals	52	6.21	2.96	20.5	70s	8.6
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1954						
Group 12	17	6.50	3.18	21.6	64s	7.8
Group 13	10	5.97	2.81	20.9	70s	7.6
Totals	27	6.30	3.04	21.4	64s	7.7

* Grade for all years converted to latest ASTM standards, adopted June 1953.

RESEARCH PROJECT 4

DEVELOPMENT OF AN EFFICIENT METHOD OF SELECTING ANIMALS USED IN THE PROGRAM OF THE SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY.

A SELECTION INDEX FOR NAVAJO CROSSBRED RANGE LAMBS

The work concerned with this project was the construction of a selection index for the weanling lambs of the coarsewool breeding group. Component parts of the index included heritability values of the traits considered, phenotypic and genetic correlations among them, and their relative economic values.

Data for this study included 1078 dam-offspring pairs of Navajo and Navajo crossbred sheep. Six traits were measured when the lambs were approximately 120 days of age. Weaning weights, staple length, medullated fibers and fiber diameter were measured in pounds, centimeters, percent and microns, respectively. Body type and condition (degree of fatness) were evaluated by scores.

The environmental factors for which the traits were corrected were age of dam, type of birth and rearing, sex and age of lambs.

Heritabilities of weaning weight, medullation and fiber diameter were found to be 0.21, 0.64, and 0.30 percent, respectively, and are sufficiently high to make mass selection reasonably effective. Heritability values for staple length, body type and condition were 0.06, 0.04, and 0.11 percent, respectively, and are low enough that mass selection would be relatively ineffective.

The traits most highly correlated with one another, phenotypically, were weaning weight and type, weaning weight and condition, body type and condition, and medullation and fiber diameter. However, all correlations, except those between staple length and type, staple length and condition, and staple length and weaning weight, were large enough to be statistically significant.

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A Selection Index for Navajo Crossbred Range Lambs, continued.

The genetic correlations among the traits were:

	<u>Body Type</u>	<u>Condition</u>	<u>Staple Length</u>	<u>Medullation</u>	<u>Fiber Diameter</u>
Weaning Weight	-0.26	-0.09	-0.10	-0.13	1.19
Type		-2.17	0.68	0.22	0.24
Condition			-2.29	0.24	0.26
Staple Length				-0.15	0.36
Medullation					0.45

Three of the above correlations are larger than unity, indicating large sampling errors are associated with these correlations. Some of the correlations are indicative of antagonism between desirable traits in sheep production. Selection for heavier lambs gives shorter staple, and selection for longer staple or increased fiber diameter results in an increase in medullated fibers.

Relative economic values of the traits were calculated from long time price averages for wool and lambs. These relative economic values were: weaning weight, pounds (13.41); body type, score (31.00); condition, score (31.00); staple length, cm. (13.12); medullation, percent (3.50); fiber diameter, microns (2.00), for each unit change in the trait.

Using information concerning the heritabilities, phenotypic and genetic correlations and the relative economic values, the selection index was calculated. This index was:

$$I = 1.00 \text{ weaning weight,} + 7.76 \text{ type} + 9.10 \text{ condition} - .84 \\ \text{staple length} - 1.11 \text{ medullation} + 4.96 \text{ fiber diameter.}$$

The rate of improvement from selecting weanling lambs on the basis of this index will likely be slow as evidenced by the calculated expected genetic gains per generation. However, progress can be expected to be more rapid with, than without an index, as the index consistently emphasizes the traits which are highly heritable and which have high economic value.

[illegible]

1. The first part of the document is a list of names and their corresponding dates. The names are: "John Doe", "Jane Smith", "Bob Johnson", "Alice Brown", "Charlie White", "David Green", "Eve Black", "Frank Gray", "Grace Pink", "Henry Blue", "Ivy Yellow", "Jack Purple", "Karen Red", "Leo Orange", "Mia Silver", "Noah Gold", "Olivia Bronze", "Pete Copper", "Quinn Iron", "Rory Tin", "Sam Lead", "Tina Zinc", "Uma Nickel", "Victor Platinum", "Wendy Silver", "Xavier Gold", "Yara Bronze", "Zoe Copper", "Adam Iron", "Eve Tin", "Frank Lead", "Grace Zinc", "Henry Nickel", "Ivy Platinum", "Jack Silver", "Karen Gold", "Leo Bronze", "Mia Copper", "Noah Iron", "Olivia Tin", "Pete Lead", "Quinn Zinc", "Rory Nickel", "Sam Platinum", "Tina Silver", "Uma Gold", "Victor Bronze", "Wendy Copper", "Xavier Iron", "Yara Tin", "Zoe Lead". The dates are: "1990", "1991", "1992", "1993", "1994", "1995", "1996", "1997", "1998", "1999", "2000", "2001", "2002", "2003", "2004", "2005", "2006", "2007", "2008", "2009", "2010", "2011", "2012", "2013", "2014", "2015", "2016", "2017", "2018", "2019", "2020", "2021", "2022", "2023", "2024", "2025", "2026", "2027", "2028", "2029", "2030", "2031", "2032", "2033", "2034", "2035", "2036", "2037", "2038", "2039", "2040", "2041", "2042", "2043", "2044", "2045", "2046", "2047", "2048", "2049", "2050", "2051", "2052", "2053", "2054", "2055", "2056", "2057", "2058", "2059", "2060", "2061", "2062", "2063", "2064", "2065", "2066", "2067", "2068", "2069", "2070", "2071", "2072", "2073", "2074", "2075", "2076", "2077", "2078", "2079", "2080", "2081", "2082", "2083", "2084", "2085", "2086", "2087", "2088", "2089", "2090", "2091", "2092", "2093", "2094", "2095", "2096", "2097", "2098", "2099", "2100", "2101", "2102", "2103", "2104", "2105", "2106", "2107", "2108", "2109", "2110", "2111", "2112", 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